Sect H

THE UNIVERSITY
OF MICHIGAN
MAR 9 1961
ENGINEERING
LIBRARY

NUCLEAR SCIENCE ABSTRACTS

Volume 15 Number 3

Abstracts 2371–3771

February 15, 1961

UNITED STATES ATOMIC ENERGY COMMISSION
Office of Technical Information

USAEC DEPOSITORY LIBRARIES

Collections of USAEC reports are maintained in the libraries of the organizations listed below for reference use by the general public. Facilities for making photocopies are available. The USAEC also makes available through these libraries atomic energy reports of countries other than the U. S. that are abstracted in *Nuclear Science Abstracts*.

ALABAMA
Auburn, Auburn University
Birmingham, Public Library

ARIZONA
Tucson, University of Arizona

ARKANSAS
Fayetteville, University of Arkansas

CALIFORNIA
Berkeley, University of California
Los Angeles, University of California
Menlo Park, Stanford Research Institute
San Diego, Public Library

COLORADO
Denver, Public Library

CONNECTICUT
New Haven, Yale University

DELAWARE
Newark, University of Delaware

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Coral Gables, University of Miami
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

ILLINOIS
Chicago, John Crerar Library
Chicago, University of Chicago
Evanston, Northwestern University
Urbana, University of Illinois

INDIANA
Indianapolis, Public Library
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky
Louisville, University of Louisville

LOUISIANA
Baton Rouge, Louisiana State University
New Orleans, Tulane University

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Harvard University
Cambridge, Massachusetts Institute of Technology

MICHIGAN
Ann Arbor, University of Michigan
Detroit, Public Library

MINNESOTA
Minneapolis, University of Minnesota

MISSOURI
Kansas City, Linda Hall Library
Rolla, University of Missouri School of Mines and Metallurgy
St. Louis, Washington University

MONTANA
Bozeman, Montana State College

NEVADA
Reno, University of Nevada

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Buffalo, University of Buffalo
Ithaca, Cornell University
New York, Atomic Industrial Forum, Inc.
New York, Columbia University
New York, Public Library
Rochester, University of Rochester
Schenectady, Union College
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Charlotte, Charlotte and Mecklenburg County Public Library
Durham, Duke University
Raleigh, North Carolina State College

OHIO
Cincinnati, University of Cincinnati
Cleveland, Public Library
Columbus, Ohio State University
Toledo, University of Toledo
Youngstown, Youngstown University

OKLAHOMA
Stillwater, Oklahoma State University

OREGON
Corvallis, Oregon State College
Portland, Reed College

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
Rio Piedras, University of Puerto Rico

RHODE ISLAND
Providence, Brown University

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee
Memphis, Public Library
Nashville, Joint University Libraries

TEXAS
Austin, University of Texas
College Station, Agricultural and Mechanical College of Texas
Dallas, Southern Methodist University
Houston, Rice Institute
San Antonio, Public Library

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin
Milwaukee, Public Library

WYOMING
Laramie, University of Wyoming

TABLE OF CONTENTS

Volume 15, Number 3, February 15, 1961

Category	Page
GENERAL AND MISCELLANEOUS	309
BIOLOGY AND MEDICINE	312
General and Miscellaneous	312
Biochemistry, Nutrition, and Toxicology	316
Fallout and Ecology	316
Radiation Effects on Living Tissues	317
Radiation Sickness	329
CHEMISTRY	337
General and Miscellaneous	337
Analytical Procedures	339
General Inorganic and Physical Chemistry	342
Radiation Chemistry and Radiochemistry	346
Raw Materials and Feed Materials	351
Separation Processes	353
ENGINEERING AND EQUIPMENT	356
General and Miscellaneous	356
Heat Transfer and Fluid Flow	357
Instrumentation	361
Materials Testing	372
GEOLOGY, MINERALOGY, AND METEOROLOGY	373
HEALTH AND SAFETY	376
INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS	382
ISOTOPE SEPARATION	386
MATHEMATICS AND COMPUTERS	387
METALS, CERAMICS, AND OTHER MATERIALS	387
General and Miscellaneous	387
Corrosion	392
Fabrication	394
Properties and Structure	398
Radiation Effects	408
PHYSICS	413
General and Miscellaneous	413
Astrophysics and Cosmology	425
Cosmic Radiation	426
Criticality Studies	427
Elementary Particles and Radiations	428
Nuclear Properties and Reactions	438
Particle Accelerators	454
Plasma Physics and Thermonuclear Processes	456
Shielding	460
Theoretical Physics	461
REACTOR TECHNOLOGY	461
General and Miscellaneous	461
Power Reactors	468
Research Reactors	476
WASTE DISPOSAL AND PROCESSING	478
CORPORATE AUTHOR INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-8
REPORT NUMBER INDEX	INDEX-45
SUBJECT INDEX	INDEX-54

NUCLEAR SCIENCE ABSTRACTS

Volume 15, Number 3

February 15, 1961

GENERAL AND MISCELLANEOUS

2371 (KAPL-2000-11) REACTOR TECHNOLOGY REPORT NO. 14. CHEMISTRY. Knolls Atomic Power Lab., Schenectady, N. Y. Sept. 1960. 118p. OTS.

The papers presented cover the following subjects: analytical chemistry, spectroscopy, radiochemistry, and corrosion and coolant chemistry. Separate abstracts have been prepared for each paper. (W.L.H.)

2372 (LA-2405) SOME SEISMIC EFFECTS OF UNDERGROUND EXPLOSIONS IN CAVITIES. George L. Lamb, Jr. Los Alamos Scientific Lab., N. Mex. Feb. 29, 1960. 65p. Contract W-7405-eng-36. OTS.

The concealment of nuclear explosions by containing them within underground cavities of a size sufficient to ensure the elastic behavior of the side walls has been suggested. A number of effects created by the seismic signal radiated by an explosion in such a cavity are investigated theoretically. A résumé of a standard calculation of the Rayleigh waves generated by a source of compressional waves in a semi-infinite homogeneous elastic medium is presented. The stress concentration around a spherical cavity excised from a homogeneous elastic medium acted on by an arbitrary body force is considered. The results are then specialized to the case of a uniform gravitational field with vanishing lateral displacement. The stress distribution around a prolate spheroidal cavity in a uniform gravitational field with vanishing lateral displacement is considered. A discussion of the plastic expansion of a spherical cavity in an infinite elastic medium is presented. The seismic waves generated by an air burst are discussed. (auth)

2373 (NP-9171) RELAZIONE SULLA MISSIONE TECHNICO-NUCLEARE NEGLI STATI UNITI D'AMERICA, SETTEMBRE 1959. (Report on the Technical-Nuclear Mission in the United States of America, September 1959). Associazione Nazionale per il Controllo della Combustione. Comitato per le Sicurezza e l'Economia degli Impianti Nucleari, Rome. 1960. 380p.

A report is given of a trip to the USA. The purpose of the trip was to study atomic energy activity. The report gives information on programs, legislation, controls, and technical standards. Descriptions are given of the numerous nuclear plants visited. (T.R.H.)

2374 (ORNL-3004) HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1960. Oak Ridge National Lab., Tenn. Nov. 4, 1960. 122p. Contract W-7405-eng-26. OTS.

Homogeneous Reactor Test (HRT). The program of reactor maintenance and major repairs to the core tank was continued. A sample of the core wall at the edge of the upper hole was cut and removed from the reactor for metallographic examination, and the circular opening left by the core sample was reamed to receive a conical patch. Tools were developed and used successfully to remove cut-up screen strips from the tee-section of the core access piping. Maintenance on other reactor parts included the replacement of the fuel system primary and secondary recombiners and the replacement of the fuel-condensate block valves. Instrument maintenance was also performed. Macro- and micro-examinations of the specimen from the core wall showed conclusively that the hole was formed by melting through the core wall with an external heat source. The HRT core-vessel thickness was measured, using a remote manipulator and ultrasonic measuring equipment. The improved multiclone was fabricated and tested in preparation for installation with the reverse-flow fuel-circulating pump. A 450-gpm canned-motor fuel-circulation pump, which will be used to reverse the direction of flow in the reactor, was pretreated and tested to obtain hydraulic-performance data. The maximum pressure rise in the HRT following a cold-water accident was calculated for upward core-fluid flow and for reversed flow. The possibility of a criticality accident in transferring irradiated fuel solution from the HRT was investigated. Engineering Development. The cylindrical re-entrant core model, 2 ft in diameter and 6 ft long, was tested further. A general arrangement layout of a 400 Mw(t) reactor vessel with a ThO_2 pellet blanket was completed to define the mechanical details of this type of reactor vessel. A 200 Z pump fitted with alumina bearings continued to operate satisfactorily. The 300-SM slurry system was tested successfully for almost 2000 hr. A slurry of 1600°C-fired ThO_2 circulated in 200 B loop for 3200 hr showed no deposition of ThO_2 on a heat-transfer surface. Four sets of Kennametal grade KH (tungsten carbide) and Kentanium 162 B (titanium carbide) valve trim were received and will be tested in slurry service. Solution Fuels. Measurements were made of the relative dissolution rates of various solids at 250°C in oxygenated, well-stirred, synthetic HRT fuel solution. The solids tested were UO_2, U_3O_8, UO_3, and $CuO \cdot 3UO_3$. Liquid-liquid equilibria and critical temperatures were determined in the system $UO_3-SO_3-D_2O$. The system $NiO-SO_3-H_2O$ was investigated at temperatures above 300°C in an attempt to find liquid-liquid immiscibility and to define this subsystem of the multicomponent system $UO_3-CuO-NiO-SO_3-H_2O$. Previous studies of $Th(NO_3)_4$ solutions were extended by an investigation of the solution-solid equilibrium boundaries of the system $ThO_2-HNO_3-H_2O$ at 200 and 300°C. The corrosion of types 347 and cast CD4MCu stainless steel was investigated in a simulated fuel solution. Corrosion tests with Coors Al_2O_3 in water at 100 and 300°C and in a simulated fuel solution at 100°C are reported. The radiation corrosion of Zircaloy-2 specimens in fuel solutions was investigated. Corrosion rates for two chemically polished crystal-bar zirconium core-annulus coupons were observed to be greater than for Zircaloy-2. Three chemically polished Zr–1Cr core-channel coupons corroded at about the same rates as Zircaloy-2. Specimens

of Zr-15Nb, Zr-15Nb-2Mo, and Zr-Nb-1 Cu in β-quenched condition showed better corrosion resistance than Zircaloy-2. Slurry Fuels. The effect of pH level on the laminar-flow properties of flocculated ThO_2 suspensions was determined. Sedimentation particle-size analyses of two sets of ThO_2 powders fired at 650, 800, 900, and 1500°C and irradiated to 7 and 6×10^{20} nvt showed decreases in the average particle sizes of the oxides. Gas recombination studies with aqueous ThO_2–UO_2 slurries containing a palladium catalyst indicated that recombination was influenced by the past history of the slurry-catalyst system. The preparation and testing of ThO_2 pellets is reported. Hydriding of zirconium-base alloys was studied in toroid tests which were conducted to evaluate the effects of slurry flow velocity and of operating temperature. Fuel Manufacture. The fabrication of ThO_2 and U–ThO_2 pellets is reported. Metallurgy. A study conducted on the effects of β homogenization and quenching variables on the ω-phase formation in Zr-15Nb alloy showed that higher homogenization temperatures, longer homogenization times, higher quenching temperatures, faster quenching rates, and shorter aging times at room temperature decrease the incubation time for the formation of the ω phase at 400°C. Early results from a study of the β quench and reheat and of the true isothermal transformation behavior of Zr-1Cu, Zr-1.6Cu, Zr-4Mo, and Zr-7.5Mo alloys indicate that age-hardening transformations occur at 400 and 500°C and that, if such transformations occur at 600 and 700°C, the alloys have overaged at the shortest times studied. (For preceding period see ORNL-2947.) (W.L.H.)

2375 (TID-6354) INVESTIGATION OF ON-SITE INSPECTION TECHNIQUES FOR HIGH-EXPLOSIVE TESTS IN A SALT MINE. Final Report. Robert B. Hoy and Bernard J. O'Neill, Jr. Stanford Research Inst., Menlo Park, Calif. June 1960. 77p. Project COWBOY. SRI Project SU-2993. OTS.

AEC experiments for testing the effectiveness of decoupling provided a further opportunity to investigate techniques which an inspection team might use to locate a clandestine nuclear explosion. The investigation consisted of aerial-photographic interpretation, geologic mapping, and on-site examination, both surface and underground. The effects of a series of 11 shots were documented; characteristics of anomalous activity were determined, and evidence of human activity and other clues were tabulated. Results of the investigation indicate that detecting and locating a clandestine underground explosion in an environment similar to the Winnfield salt dome would be difficult. The detection problem was highlighted by experiments conducted by LRL which proved that the seismic signal from an underground detonation can be substantially reduced by decoupling methods. Thus it is conceivable that the seismic signal from a clandestine decoupled test might not be noted in an inspection control system, especially in an area where seismic signals from natural causes are common. However, if a seismic signal from any of the COWBOY test shots had been detected, locating the site of the event would have been possible; the chance of success would have decreased as the evidence of anomalous on-site human activity was eliminated. This research emphasized the necessity that an inspection team be cognizant of the geologic environment and seismic history of the area under its surveillance and that the team be extra-sensitive to any anomalous activity. (auth)

2376 (TID-6669) PROJECT HOBO, GROUTING SUPPORT. Miscellaneous Paper No. 6-409. J. M. Polatty. Waterways Experiment Station, Vicksburg, Miss. Aug. 1960. 22p. OTS.

The grouting operation conducted in connection with Project HOBO consisted of four high-explosive shots made underground in tuff at the Nevada Test Site to permit a comparison between the seismic signal generated by a contained explosion in tuff and that produced by a tamped detonation in salt. To obtain shot data, three sets of instruments were placed in holes at the test site. Grouting mixtures were specially designed to match the density and sonic velocity of the in-situ material in which the instrument holes were drilled, and the instrument holes were pumped with these mixtures after the instruments were embedded. Three shot holes were drilled and pumped with a quick-setting grout mixture for containing the detonation of the high explosive, Pelletol, and a fourth hole was drilled and filled with a special set of mixtures to provide a dry hole for the detonation of the Pelletol. Field-cast grout specimens were tested in the laboratory. The field grouting was considered successful, and laboratory test results of the field-cast specimens checked with the results of density tests made in the field. (auth)

2377 (UCRL-5843) SEISMIC DECOUPLING FOR EXPLOSIONS IN SPHERICAL CAVITIES. W. M. Adams and D. S. Carder. California. Univ., Livermore. Lawrence Radiation Lab. Sept. 30, 1960. 27p. Contract W-7405-eng-48. OTS.

A series of paired explosions in a salt mine near Winnfield, La., was conducted to test a theory concerning seismic decoupling by underground cavities. The theory predicted a decoupling of about 100. Free-field and surface measurements from an explosion in either a 6 or 15-ft-radius spherical cavity were compared with similar measurements from a completely tamped explosion. Shot sizes were from 20 lb up to a few tons. Surface measurements were made out to 100 km and covered the frequency range from 0.05 to 100 cycles. The experiment confirmed that decoupling does occur. The actual decoupling factor as a function of frequency is presented and compared with the theory. (auth)

2378 (WAPD-BT-20) BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh. Sept. 1960. 132p. Contract AT-11-1-GEN-14 and appropriate NObs-Contracts. OTS.

This review covers research on irradiation effects, sintering of oxides, mechanical and physical properties of materials, film gages, hydrodynamics, and fuel elements. Separate abstracts have been prepared for the 10 papers. (W.L.H.)

2379 (JRPS-6176) INFORMATION ON NUCLEAR SCIENCE IN YUGOSLAVIA. Translated from Privredni Pregled (Belgrade) 10(1960) Aug. 18p. OTS.

Selected articles from Privredni Pregled (Economic Review), Belgrade, Vol. X, Aug. 1960, are presented. Articles cover nuclear power, a five-year plan, radiography, uranium ores, and various research institutes. (W.D.M.)

2380 PRESENT STATE OF THE APPLICATION OF NUCLEAR ENERGY. H. Menze (BBC-Krupp, A. G., Düsseldorf and Mannheim, Ger.). Atom u. Strom 6, 79-83 (1960) Sept. (In German)

A survey is given on the present known possibilities of the energy economics of the world. The contribution of the individual energy sources is estimated. The more accurate analysis of the energy market made for Europe and especially for Germany showed that the introduction of nuclear energy is not necessarily vital but from a realistic estimation of the cost factors would be economic. For the obten-

tion of this aim, nuclear power plants must comply with predetermined provisions, which are discussed. (tr-auth)

2381 POSSIBILITIES FOR THE UTILIZATION OF UNDERGROUND NUCLEAR EXPLOSIONS FOR SCIENTIFIC AND TECHNOLOGICAL PURPOSES. W. Kliefoth. Atomkernenergie 5, 384-6(1960) Oct. (In German)

The latest American investigations on the utilization of underground nuclear explosions for scientific and technological purposes are reviewed. The Gnome project is described in some detail. (J.S.R.)

2382 PHYSICS AND MEDICINE OF THE ATMOSPHERE AND SPACE. Otis O. Benson, Jr. and Hubertus Strughold, eds. Proceedings of The Second International Symposium on the Physics and Medicine of the Atmosphere and Space held at San Antonio, Texas, November 10, 11, 12, 1958. New York, John Wiley & Sons, Inc., 1960. 657p.

Forty-two papers are included on a variety of topics such as radiation hazards in space, composition of the atmosphere, propulsion systems for space travel, space medicine, and environments of other planets. Separate abstracts have been prepared for 7 papers; 1 paper was previously abstracted in NSA. (D.L.C.)

2383 A SURVEY OF POSSIBLE PROPULSION SYSTEMS. L. R. Shepherd (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.217-49 of "Physics and Medicine of the Atmosphere and Space."

An extensive survey of possible propulsion systems for space vehicles is presented in which the systems are classified as high-thrust and low-thrust devices, the former for blast-off from earth and the latter for take-off from an orbit. Of the high-thrust systems, the conventional chemical propellants, providing specific impulses up to 400 sec, will remain dominant in all space operations up to satellite launchings, although for more ambitious space flight projects, e.g., a trip to and from the moon, nuclear devices would probably be used since they can develop impulses up to 800 or 1000 sec. Unconventional chemical propellants (radicals and metastable atoms) are also considered. Low-thrust systems, on the other hand, are not yet sufficiently advanced, but plasma generators and fusion devices (especially of the $Li^7 + H^1$ reaction type) appear promising. (D.L.C.)

2384 CLOSED-CYCLE MONOPROPELLANT FUEL CELL SYSTEM EMPLOYING RADIATION-GENERATED OR PHOTOCHEMICALLY GENERATED OZONE. Jozef Willem Eerkens and Martin C. Reder (Aerojet-General Nucleonics, San Ramon, Calif.). Paper No. 1306-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 29p.

A new photochemical nuclear energy conversion system is described which is based on the following conversion steps. Kinetic energy of photons or nuclear particles (gammas, betas, protons, alphas, fission fragments) is transferred into chemical energy of recombination through the exposure of oxygen to sunlight in the exosphere or through irradiation of oxygen in a nuclear chemogenic reactor or isotopic irradiator, which causes oxygen to recombine (partially) to ozone after photolysis or radiolysis. The efficiency of this chemical energy storage process varies between 10 and 15%, depending on the operating conditions. The ozone (mixed with oxygen) is then passed over a specially treated porous electrode of a fuel cell, at which the ozone reacts with the electrolyte. At the other electrode of the cell, oxygen is liberated. The over-all reaction is the formation of oxygen from ozone with the liberation of two 0.84 ev electrons. By recycling the anodic oxygen to the sunlight exposure region, or to the irradiator or reactor, it is converted to ozone again and a closed-cycle system is obtained. Preliminary calculations were made of the temperature and pressure dependence of the open-circuit cell potential and of oxygen overpotentials on various electrode materials under varying operating conditions (temperature, pressure, electrolyte flow rate). Possible electrode side reactions, as well as ozone stability and decomposition kinetics, were also investigated. These preliminary studies indicate the over-all feasibility of the system. For space applications, a typical 100 watt (d-c electrical) unit employing radioactive krypton mixed with oxygen would weight 130 lb if beryllium is used for containment or 160 lb if stainless steel is used. Total volume would be approximately 10 ft^3. Average operating temperature and pressure of the gas would be 212°F and 100 atm, and approximately 2500 kc of Kr^{85} would be required. Operating life would be approximately 10 years. (auth)

2385 13-WATT ISOTOPE-POWERED THERMOELECTRIC GENERATORS FOR SPACE AND LUNAR IMPACT MISSIONS. Justin L. Bloom and James B. Weddell (Martin Co., Baltimore). Paper No. 1332-60. [Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960]. 28p.

Two small thermoelectric generators that derive their power from the radioactive decay of Cm^{242} were designed. The first is intended for use in space and is capable of delivering an essentially constant power output of 13 electrical watts over a 6-month operational life. It weighs 16.6 lb and occupies a volume of 230 in^3. The second generator is designed to operate for 2 months, both in lunar day and night, after a hard (500 ft/sec) impact on the moon. The principles of design are described. The complete power supply weighs 6.2 lb and occupies a volume of 350 $in.^3$, including allowances for mounting structure and radiator surfaces. In both cases, external radiation levels may be reduced to the point where personnel exposure in ground handling and photon dosage to neighboring instrumentation are minimized. Thermal-to-electrical conversion principles, properties of the radioisotope fuel, method of encapsulation of the fuel and techniques for obtaining constant power output are discussed. Safety considerations in the event of accidents during launch-to-operation sequence are presented briefly. (auth)

2386 SAFETY ANALYSES AND TESTS OF A RADIOISOTOPE POWERED THERMOELECTRIC GENERATOR. Paul J. Dick (Martin Co., Baltimore). Paper No. 1341-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 14p.

An interesting and important aspect in the development of a radioisotope-powered thermoelectric generator for space application includes the assurance of radiological safety under all operational conditions. The many facets of this work include: Hot-cell fuel-core loading, transportation of the radioisotope fuel core, fuel-core transfer to the generator, generator shielding, launch abort procedures, launch-pad-flight vehicle-failure conditions, launch-ascent-flight vehicle-failure conditions, and reentry from extra-terrestrial flight. The portion of an extensive safety program dealing with flight vehicle failure and reentry from orbital flight is discussed. In particular, the analyses and tests that were conducted to establish

complete radioisotope fuel containment in the cases of vehicle failure on the launch pad, vehicle failure during launch ascent, and fuel burnup at high altitude in the case of reentry from orbital flight are highlighted. The various tests conducted to demonstrate a safe environment during the life of the radioisotope fuel are reviewed. Included in this summary are: high-velocity fuel-core impact tests, high-temperature fire tests, explosion and shock tests, LOX immersion tests, corrosion and material compatibility tests, and plasma jet reentry burnup tests. (auth)

2387 INDEX TO THE ANNUAL REPORT TO CONGRESS FOR 1959. Major Activities in the Atomic Energy Programs, January 1959–December 1959. Atomic Energy Commission, Washington, D. C. 1960. 68p. $0.25(GPO).

2388 RARE EARTH ELEMENTS (1940-1960). OTS SELECTIVE BIBLIOGRAPHY. Office of Technical Services, Washington, D. C. Mar. 1960. 20p. (SB-404). OTS.

A bibliography of about 450 reports listed in the OTS abstract journals U. S. Government Research Reports and Technical Translations on rare-earth elements is presented. (J.R.D.)

2389 RADIOACTIVE BATTERY. (to Universal Winding Co.). British Patent 853,930. Nov. 9, 1960.

A compact and efficient radioactive battery was invented comprising a dielectric glass ampoule enclosed by a conductive casing and filler (e.g., powdered metal) and coated on its inner surface with a conductive material such as silver. The dimensions of the assembly are such that electrons emitted by fluid radioactive material contained inside the ampoule pass through the ampoule to the casing but not beyond, and that backscatter secondary electrons from either casing or filler are prevented from passing back to the ampoule. In operation the electron emission causes electric current to flow from the casing to the ampoule costing. The radioactive material can be Kr^{85}, Cl^{36}, Xe^{133}, etc. For Kr^{85} this battery can build up an open-circuit equilibrium voltage of ~10,000 volts and deliver a current of ~1 mμa for each curie. The dimensions of a configuration for Kr^{85} are given. (D.L.C.)

BIOLOGY AND MEDICINE

General and Miscellaneous

2390 (AD-237433) HISTOPATHOLOGIC EVALUATION OF EFFECT OF DIET ON RESISTANCE TO RADIATION DAMAGE AND TO DEVELOPMENT OF ATHEROMATOUS LESIONS. Report No. 3 (Progress) [for] June 1, 1959–August 31, 1959. Paul B. Szanto. Hektoen Inst. for Medical Research, Chicago. 5p. Project No. 7-84-13-002A. Contract DA19-129-qm-1334.

A histopathologic evaluation of the morphologic findings on guinea pigs receiving two types of diet is given. The morphologic changes in animals on different diets with whole-body irradiation are also presented. (T.R.H.)

2391 (AERE-R-3423) STRONTIUM STUDIES. Katharine Williams. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Sept. 1960. 57p. BIS.

Results are reviewed from a number of studies on the biological effects of radioactive strontium in laboratory animals and man. Data are included on factors affecting the uptake, metabolism, and excretion of Sr^{89} and Sr^{90}; late and chronic effects of radiostrontium; carcinogenic effects; radiation effects in the skeleton; the effects of calcium levels on strontium distribution and excretion; the comparative dosimetry of Sr^{90} and radium; and the turnover and mechanism of fixation of strontium. 94 references. (C.H.)

2392 (COO-222) RESEARCH IN RADIOBIOLOGY. Semi-Annual Report of Work in Progress on the Chronic Toxicity Program. Thomas F. Dougherty. Utah. Univ. Salt Lake City. Coll. of Medicine. Sept. 30, 1960. 143; Contract AT(11-1)-119. OTS.

A tabulated summary of the toxicity studies of Ra, Pu, Th, and Sr is presented. In a redetermination of the half life of Ra^{228}, a value of 5.84 ± 0.06 yr was obtained. A report is given of the study of soft-tissue tumor incidence in beagles with long-term internal radionuclide burdens. A terminal report is made of detailed observations and measurements made on 15 test dogs injected with radium. (T.R.H.)

2393 (HW-63173) DECONTAMINATION OF PLANTS EXPOSED TO A SIMULATED REACTOR BURN. F. P. Hungate, J. D. Stewart, R. L. Uhler, and J. F. Cline. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. July 1, 1960. 18p. Contract AT(45-1)-1350. OTS.

A variety of plants was exposed to the products of a melted fuel element in a simulated reactor burn. Leaves were then washed in laboratory tests to determine percentage removal of I^{131}, $Ru^{103,106}$, and Cs^{137}. From 60 to 90% of the I^{131} was removed. Distilled water was least effective and a household detergent was most effective as a decontaminating agent. By surface stripping, it was shown that less than 10% of the I^{131} was in the mesophyll tissue of leaves. Autoradiograms showed some distinct hot spots, presumed to be particulate, but also showed a diffuse deposit of activity on the leaves with a heavier concentration at the leaf margins. Since this marginal activity could be removed by plastic coatings, it was concluded to have resulted from dynamics of deposition rather than to transport within the leaf. (auth)

2394 (TID-4041) GENETICS RESEARCH PROGRAM OF THE DIVISION OF BIOLOGY AND MEDICINE. Division of Biology and Medicine, AEC. Jan. 1960. 120p. OTS.

The Atomic Energy Commission and its predecessor, the Manhattan Engineering District, have supported a number of studies on the genetic effects of radiation. Abstracts are presented of the individual research projects in effect in 1960. The name or names of the investigators, the home institution, and the title of each project are included. (C.H.)

2395 (TID-6735) STUDIES ON BONE DEMINERALIZATION WITH EMPHASIS ON THE REMOVAL OF STRONTIUM. Annual Progress Report and Renewal Proposal. Irwin Clark. Columbia Univ., New York. Coll. of Physicians and Surgeons. [1960]. 7p. Contract AT(30-1)-2530. OTS.

The elimination of recently ingested Sr^{89} in rats was studied. Citrate ion, magnesium ion, and adrenal cortical steroids and combinations of these substances were administered to the rats 48 hr after ingestion. Preliminary results on growing rats revealed that these treatments had no effect or decreased the excretion of the isotope. In the adult rat, administration of the same materials resulted in a significant increase in the elimination of Sr^{89}. The magnesium ion increased the excretion of Sr^{89} in the adult rat. The addition of citrate or prednisolone was synergistic with magnesium. In studies on Sr^{89} removal from the bone

of adult rats, it was found that magnesium produced an increased elimination. Citrate and prednisolone and citrate plus prednisolone, when combined with magnesium, decreased the elimination of Sr^{89} below that of magnesium alone. In studies on the substitution of Be, Ca, Sr, and Ba for Mg, all elements with the exception of barium increased the elimination of Sr^{89}. (C.J.G.)

2396 (TID-6736) EFFECT OF CHELATING AGENTS ON THE REMOVAL OF YTTRIUM AND LANTHANUM FROM MEN. Betty Rosoff, Seymour Ritter, Kathleen Sullivan, Hiram Hart, and Herta Spencer-Laszlo. Montefiore Hospital, New York. [June 1960]. 11p. Contract AT(30-1)-1763.

Yttrium chelate excretion studies stimulated by the interest in the removal of fission products from man were conducted. Since diethylenetriamine pentaacetic acid (DTPA) has a high affinity for yttrium and is almost quantitatively excreted in 24 hr, the effectiveness of DTPA in removing yttrium from the body was studied in eight patients. Yttrium was injected intravenously as the nitrilotriacetate (Y^{90}-NTA), a weak chelate, and, 24 hr later, 500 mg DPTA was infused daily on 4 successive days. The Y^{90} excretion was then compared with the results obtained with equivalent amounts of EDTA. The effectiveness of 2 g of either chelate was also studied. The infusions of 500 mg DTPA increased the yttrium excretion 4 to 8 times over the base-line excretion. DTPA was more effective than EDTA, and a fourfold increase of either chelate did not result in an appreciably higher excretion of the metal chelate than was achieved with the 500-mg dose. In studies carried out in two patients, doses of 100 mg DTPA were found to be less effective than 500 mg of this chelating agent. Similar studies of the removal of La^{140} indicate that DTPA is also more effective than EDTA in removing this rare-earth isotope from man. The significance of these decontamination studies and their possible application for fission-product removal are discussed. (auth)

2397 (TID-6737) METABOLISM OF STRONTIUM-85 AND CALCIUM-45 IN MAN. Herta Spencer, Margaret Li, Joseph Samachson, and Daniel Laszlo. Montefiore Hospital, New York. [Sept. 1959]. 22p. Contract AT(30-1)-1763. OTS.

Presented in part at the Meeting of the Federation of the American Society for Experimental Biology, Philadelphia, April 1958.

The comparative metabolism of radiostrontium and radiocalcium using Sr^{85} and Ca^{45} as tracers was studied under controlled dietary conditions in man. A single tracer dose of both radioisotopes was administered simultaneously by the intravenous route to five patients, by the oral route to 11 patients, and by the oral and intravenous route at different times to two patients. Three patients received tracer doses of Sr^{85} and Ca^{45} orally in separate doses. Preferential urinary excretion, higher renal clearance, and lower body retention of Sr^{85} than of Ca^{45} were noted following the intravenous injection of the tracers; the ratio of Sr^{85}/Ca^{45} excretion ranged from 2.3 to 3.8 and averaged 2.8. Following the administration of tracer doses of Sr^{85} and Ca^{45}, it was found that Sr^{85} was poorly absorbed from the gastrointestinal tract. The ratio of Ca^{45}/Sr^{85} absorption ranged from 1.9 to 3.5 and averaged 2.6. The main pathway of excretion of Sr^{85} is via the kidney. A considerably greater percentage of the absorbed fraction of the dose of Sr^{85} than of Ca^{45} was excreted in the urine; approximately 40% or more of the absorbed dose of Sr^{85} was excreted in the urine in 12 days by 50% of the patients studied. The ratio of urinary excretion of Sr^{85}/Ca^{45} in terms of the absorbed dose of both radioisotopes averaged 3.7. Due to the poor gastrointestinal absorption and the preferential urinary excretion of the absorbed radiostrontium, the body burden of Sr^{85} is considerably lower than that of Ca^{45}. (auth)

2398 (TID-6763) METABOLISM OF ALKALINE EARTH METALS. Renewal Proposal and Annual Progress Report for November 1, 1959 through July 31, 1960. Oliver Cope and Benjamin A. Barnes. Harvard Univ., Boston. Medical School. 33p. Includes Appendix A: COMPARISON OF MAGNESIUM AND POTASSIUM EFFLUX FROM INCUBATED RAT DIAPHRAGMS. George May and Benjamin A. Barnes. Contract AT(30-1)-2092. OTS.

Activities in programs to investigate exchangeable magnesium measurements in intermediate grade alcoholics, potassium and magnesium efflux measurements from the incubated rat diaphragm, evaluation of exchangeable magnesium measurement technique in dogs, and rate constant measurements of the efflux of radiopotassium and radiomagnesium from incubated rat diaphragms are reported. (J.R.D.)

2399 (TID-6925) THE DEVELOPMENT OF CHELATING AGENTS FOR ENHANCING THE URINARY EXCRETION OF STRONTIUM. Report No. 3 [for] Period Covering September 1, 1959–September 1, 1960. Harry Kroll. Montefiore Hospital, New York. Oct. 2, 1960. 30p. Contract AT(30-1)-2094. OTS.

Progress is reported in the development of chelating agents for enhancing the urinary excretion of radiostrontium. Four new polyamineacetic acids were synthesized. The alkaline-earth stability constants of several compounds were determined. The effects of inorganic salts of magnesium and sulfate on the urinary excretion of Sr^{85} in rats were studied. Data are tabulated. (C.H.)

2400 (UR-581) RADIUM IN BONE AND SOFT TISSUES OF MAN. J. B. Hursh, A. Lovaas, and E. Biltz. Rochester, N. Y. Univ. Atomic Energy Project. Oct. 11, 1960. 11p. Contract W-7401-eng-49. OTS.

Analyses of Ra^{226} in human autopsy samples of soft tissues and bone from 11 normal subjects yield average values for bone of 3.4×10^{-15} g Ra^{226} per gram wet tissue and for soft tissues from 0.05 to 0.1×10^{-15} g Ra^{226} per gram wet tissue. A rough approximation suggests that at least 78% of the naturally acquired body radium is in the bone. (auth)

2401 (USNRDL-TR-460) TRABECULAR AND CORTICAL BONE COMPOSITION. J. K. Gong, J. S. Arnold, and S. H. Cohn. Naval Radiological Defense Lab., San Francisco. Sept. 6, 1960. 21p.

Marrow-free trabecular bones from dog, man, monkey, and steer were obtained by use of a special marrow-washing technique. The quantities of the various trabecular bone fractions (water, organic, volatile inorganic, and nonvolatile inorganic [ash]) found in these animals were compared with those of cortical bone. The components of each of the two types of bones from the four species were found to be quantitatively similar to each other. However, the over-all density of the cortical bone was higher than that of the trabecular bone. The higher density was due to a higher ash and a lower water content found in the cortical than in the trabecular bone. On the basis of the values found, graphs were prepared and the methods for the calculation of the volume and mass of the various bone fractions when given the mass and the ratio of trabecular to cortical ash were demonstrated. (auth)

2402 (JPRS-2688) RADIOACTIVE IODINE IN THE THERAPY OF THYROTOXICOSIS. K. D. Eristavi, T. O.

Zhvaniya, N. N. Kebadze, and M. G. Gachicheladze. Translated from Problemy Endokrinol. i Gormonoterap. 6, No. 1, 102-5(1960). 8p. OTS.

If treatment of patients with thyrotoxicosis with radioactive iodine does not replace, in some cases, radical surgical intervention, it is without doubt an effective conservative means of treatment in thyrotoxicosis of light degree as well as in medium and severe forms of the disease, especially in those cases when surgical treatment cannot be performed for various causes. The study of a fractional method of dosaging I^{131} in small and medium doses showed good therapeutic effect in application of medium doses, the rationality of their repeated application (3 to 4 times) at intervals of 6 days, and the absence of therapeutic effect in application of small doses of I^{131} in patients with medium and serious forms of thyrotoxicosis. The treatment with radioactive iodine may also be conducted ambulatorily under conditions of relapse of thyrotoxicosis after subtotal resection of thyroid gland, absence of effect in medicinal therapy, refractivity, and idiosyncrasy to iodine preparations and thiouracil, combination of thyrotoxicosis with other diseases, refusal by patients of surgical therapy, as well as in patients of advanced age, when surgical intervention is connected with the risk of the patient's life. (auth)

2403 (JPRS-2706) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, Volume IV, No. 9, p.13-17; 24-8; and 66-90, 1959. 69p. OTS.

2404 (JPRS-5041) BETA-RADIATION IN HUMAN BLOOD IN MALIGNANT NEOPLASMS AND CERTAIN BLOOD DISEASES. A. I. Danilenko and I. N. Shevchenko. Translated from Fiziol. Zhur. S.S.S.R. 6, No. 1, 114-16 (1960). 7p. OTS.

Measurements were made of the natural β activity of the blood of 147 individuals. The group included 45 healthy persons; 40 cancer patients; 30 patients with ulcer, chronic gastritis, and polyposis; and 32 patients with chronic leukemia or polycythemia. None of these patients had been treated with radioactive isotopes or x radiation. The β activity of the blood samples was attributed to the radiation from potassium. Results indicate that in both normal and disease states there are certain definite values of natural β activity in the blood. Possible diagnostic applications are discussed. (C.H.)

2405 (NP-tr-429) BISMUTH-206 COMPLEXES IN EXPERIMENTAL LEUKAEMIA IN MICE. I. F. Passalacqua. Translated by A. Schoenfeld (U.K.A.E.A. Atomic Energy Research Establishment) from Strahlentherapie 108, 257-61(1959). 8p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 9664.

2406 ATTEMPTS TO INFLUENCE THE ELIMINATION OF RADIOSTRONTIUM. Birger Carlqvist and Arne Nelson (Research Inst. of National Defence, Sundbyberg, Sweden). Acta Radiol. 54, 305-15(1960) Oct. (In English)

The effect of $SrCl_2$, Sr-lactate, $CaCl_2$, Ca-lactate, Na-lactate, $CaNa_2$-EDTA and $CaNa_2$-citrate on the deposition of radiostrontium was examined in mice. Of the tested agents, only strontium salts and calcium sodium citrate were able to decrease the retention if given within ½ hr before or after the administration of radiostrontium. The optimum effect was obtained with $SrCl_2$; the effect of Sr-lactate was less. All the other agents increased the retention. (auth)

2407 CHECKING OF ARTIFICIAL RADIOELEMENTS FOR MEDICAL USE IN FRANCE. Yves Cohen (Centre d'Études Nucléaires, Saclay, France). Ann. pharm. franç 17, 250-60(1959) Apr. (In French). (CEA-1483)

Radioactive preparations destined for administration to humans in medical diagnosis or therapy are subjected to a special check known as a "pharmaceutical control," consisting of physical, chemical, and biological tests to verify their radioactive and radiochemical purity and their biological safety. The rules governing these checks are drawn up as a function of the preparation, properties, and use of the radioelements. Like all other injectable preparations, they must conform to the tests prescribed by the Codex. (auth)

2408 A CONVENIENT, RAPID AND SENSITIVE METHOD FOR MEASURING THE INCORPORATION OF RADIOACTIVE AMINO ACIDS INTO PROTEIN. Rusty J. Mans and G. David Novelli (Oak Ridge National Lab., Tenn.). Biochem. Biophys. Research Commun. 3, 540-3(1960) Nov.

A convenient procedure is described that permits the handling of 50 to 100 samples simultaneously with the same counting efficiency as the conventional method. The assay technique combines features of the filter-paper assay, efficient washing and extraction procedure, and a filter-paper counting procedure. (auth)

2409 PRACTICAL APPLICATION OF RADIOACTIVE METALS. D. Laszlo. Bull. N. Y. Acad. Med. 36, 520-7(1960) Aug.

Practical applications of radioisotopes in the treatment of malignancies are discussed. The use of new radioisotopes affords many advantages over radium. The three important types of applications are topical, interstitial, and palliative. Examples of these applications are described. Slides are included that point out the somewhat devious pathways by which the isotopes can be developed which may then find limited usefulness in therapy. The difficulty of evaluating the therapeutic results is emphasized. (B.O.G.)

2410 SURVIVAL OF MOUSE BONE-MARROW CELLS FROZEN AND THAWED IN SOLUTIONS OF AMINO ACIDS. T. T. Phan and M. A. Bender (Oak Ridge National Lab., Tenn.). Exptl. Cell Research 20, 651-4(1960) Sept.

An investigation was made of the survival of bone-marrow cells frozen and thawed in various ways. Mechanisms by which living cells are able to survive freezing were also investigated. (C.H.)

2411 INCORPORATION OF RADIOACTIVE SULFUR IN HAIR. Harold B. Haley and Martin B. Williamson (Stritch School of Medicine of Loyola Univ., Chicago and Cook County Hospital, [Chicago]). J. Cellular Comp. Physiol. 55, 235-7(1960) June.

The hair of human subjects given radiosulfur-labeled cystine and methionine accumulates much more radioactivity than does the skin. The high levels of radiosulfur do not appear in the hair until approximately 4 to 6 weeks after administration of the labeled compound. Although labeled cystine, methionine, and sulfate are converted to hair keratins in experimental animals, only the first two compounds are utilized in man. (auth)

2412 LABELING OF HUMAN TUMOR CELLS IN VIVO BY TRITIATED THYMIDINE. H. A. Johnson, J. R. Rubini, E. P. Cronkite, and V. P. Bond (Brookhaven National Lab., Upton, N. Y.). Lab. Invest. 9, 460-5(1960) July-Aug.

Cells of three human tumors were readily labeled by in vivo incorporation of tritiated thymidine into DNA. Autoradiographic findings indicated that the tumor cells

are turning over at approximately the same rate as normal skin. The implications of the findings are discussed. (auth)

2413 ACCUMULATION OF POTASSIUM, CESIUM^{137}, AND RUBIDIUM^{86} IN BEAN PLANTS GROWN IN NUTRIENT SOLUTIONS. J. F. Cline and F. P. Hungate (General Electric Co., Richland, Wash.). Plant Physiol. 35, 826-9 (1960) Nov. (HW-SA-1841).

By the addition of potassium to the nutrient substrate, Cs^{137} and Rb^{86} uptake by bean plants was reduced less than expected from an assumed physiological equivalence of these ions. Plants discriminated against cesium at low potassium nutrient concentrations; but with increasing substrate potassium, this discrimination diminished. Discrimination of Rb^{86} from potassium approximated that observed for Cs^{137}. Potential errors from the use of ratios in predicting uptake of Cs^{137} were discussed. Some toxicity was noted when significant quantities of nonradioactive cesium were in the nutrient solution. (auth)

2414 RELATIVE UPTAKE AND TRANSLOCATION OF POTASSIUM AND CESIUM IN BARLEY. Lawrence J. Middleton, Raymond Handley, and Roy Overstreet (Univ. of California, Berkeley). Plant Physiol. 35, 913-18(1960) Nov.

The relative rates of uptake of potassium and cesium by excised roots and by intact plants of barley from solutions have been measured by K^{42} and Cs^{137}. The results have been expressed as the observed ratio (O.R.): O.R. = (Cs^{137}/K^{42} plant)/(Cs^{137}/K^{42} solution). In excised roots, in external concentrations of potassium up to 1.0 meq/l, the O.R. was in the range of 0.15 to 0.25. At a higher concentration (10 meq/l), the O.R. was approximately 0.4, thus indicating a lower selectivity for potassium at this level. In the transfer from root to shoot, a marked effect of potassium concentration on the O.R. was observed. At a concentration of 0.1 meq/l, K^{42} was transferred at 10 to 20 times the rate of Cs^{137} (mean O.R. = 0.06). At 10 meq/l, K^{42} was transferred at only twice the rate of Cs^{137} (O.R. = 0.5). When the proportions of added stable potassium and cesium in the medium were varied over a very wide range, the O.R. was affected by a factor of less than two. When the rate of potassium uptake was low or when water movement was restricted, the O.R. in the shoots was greater than unity, showing a greater transference of Cs^{137}. (auth)

2415 MINIATURE PIG METABOLISM CAGE FOR RADIOBIOLOGICAL STUDIES. V. G. Horstman, L. A. George, M. E. Kerr, and L. K. Bustad (Univ. of Washington, Seattle). Proc. Animal Care Panel 9, 181-2(1959) Dec.

A glove-box type metabolism cage is described for the effective separation of urine and feces from various sizes of male miniature pigs administered high levels of α- and β-emitting isotopes. (auth)

2416 PHYSICAL STUDIES ON THERAPY WITH HIGH-ENERGY ELECTRON RADIATION. Rolf Wideröe (Universität, Zurich). Strahlentherapie 113, 161-77(1960) Oct. (In German)

When high-energy quantum radiation (betatron bremsstrahlung) is slowed down and scattered in a medium, primary electrons are produced whose mean energy only amounts to about 3.6 Mev at a maximum quantum energy of 25 Mev. Conditions are roughly equal at all depths in the body (except for the build-up zone). High-energy electron beams (primary electrons) produce primary ions along the track, having a relatively large spacing of 0.32 μ. In addition, they produce secondary electrons with more than 5 kev of energy (δ rays), which exhibit a far higher ion density. At the beginning of the track the spacing between δ rays is about 590 μ (E_{prim} = 30–40 Mev) on the average; toward the end of the track it is only about 170 μ. The term "linear energy transfer" (LET) employed with quantum radiation is not suitable for describing the ionic distribution of electron beams. The depth-dose curve is defined by the energy scatter and side scatter. Most tracks of the primary electrons end in the declining part of the curve. The hypothesis has been put forward that, with high-energy electron radiation, the δ tracks are of considerable importance to the relative biological effectiveness (RBE) of the radiation, on account of their greater ionization density. In the drooping part of the depth-dose curve, where the number of δ particles increases, the relative biological effectiveness will consequently be enhanced. Under certain definite circumstances the biological depth-dose curves can be obtained by calculation, and their shape is generally such that the biological effect reaches further into the body than would be expected according to physical measurements. Measurements carried out so far with the mutation test on drosophila eggs appear to confirm this. (auth)

2417 PROLIFERATION OF INJECTED LYMPH NODE AND THYMUS CELLS IN LETHALLY IRRADIATED MICE. H. S. Micklem and C. E. Ford (M. R. C. Radiobiological Research Unit, Harwell, Berks, Eng.). Transplantation Bull. 26, 436-41(1960) Oct.

Lymph node or thymus cells carrying the T6 marker chromosome were injected, together with chromosomally unmarked bone marrow, into lethally irradiated mice. Mice were sacrificed at intervals and the dividing cells in the bone marrow, spleen, thymus, and mesenteric lymph node were examined cytologically. It was found that cells derived from lymph nodes and thymus proliferated in the lymph node of the irradiated recipient and to a much smaller extent in the spleen; only exceptionally were they seen in the bone marrow or thymus. No evidence was obtained to suggest that lymph nodes and thymus normally contain any stem cell capable of differentiating into granulopoietic and erythropoietic cells. (auth)

2418 REPORT OF THE NATIONAL CHEMICAL LABORATORY, 1959. Report of the Steering Committee for the period 1st October 1958 to 31st December 1959 and Report of the Director of the National Chemical Laboratory for 1959. Gt. Brit. Dept. of Scientific and Industrial Research. 1960. 76p. $0.63.

The report of the National Chemical Laboratory Steering Committee is given for the period October 1, 1958, to December 31, 1959. Also included is the report of the director of the National Chemical Laboratory for 1959. The work done on the extraction of uranium, gold, and beryllium, the separation of rare earths, and the purification of elements is given. The preparative work for chemical thermodynamic measurements is described. Metal corrosion was studied in water circulation systems, in boilers, in the atmosphere, and underground by microbiological methods. The work in development and application of new materials included studies of the absorbent and adsorbent properties of polymers, ion- and molecule-selective membranes, hydrazine polymers, electron-exchange polymers, organoboron compounds, and the radioisotope applications unit at Harwell. Reports are given of work on molecular weight and molecular weight distribution by ultracentrifugation emission spectroscopy, visible and ultraviolet absorption spectroscopy, microanalysis, polarography, activation analysis, and the determination of beryllium. (M.C.G.)

Biochemistry, Nutrition, and Toxicology

2419 THE INTERACTION OF YTTRIUM CHELATES WITH SERUM CONSTITUENTS. Betty Rosoff (Montefiore Hospital, New York). Ann. N. Y. Acad. Sci. 88, 479-85 (1960) Aug. 18.

The nature of the interaction of yttrium chelates with serum was studied by the method of pressure filtration for determining the relative binding strength of chelating agents in physiological media. The filterability of yttrium from serum and serum filtrate was found to be related to the stability constants of the yttrium chelates. The data obtained in pressure filtration studies are in agreement with those obtained in excretion studies carried out in experimental animals and man. Equilibrium dialysis studies of the binding of yttrium chelates to albumin and γ-globulin have shown that binding of albumin occurred with only two of the yttrium chelates, ethylenediamine di(O-hydroxyphenyl-acetate), Y-EDDHA, and N, N-di(2-hydroxyethyl) glycine, Y-DHEG. The interaction of yttrium-EDDHA with albumin was further studied and this reaction was found to be reversible. An explanation for the protein binding of this yttrium chelate was proposed. (auth)

2420 STUDIES ON SODIUM IN BONE. Gilbert B. Forbes (Univ. of Rochester School of Medicine and Dentistry, N. Y.). J. Pediat. 56, 180-90(1960) Feb.

A survey is given of investigations of skeletal sodium. A comparison of values obtained in adults by the isotopic dilution technique with those reported for carcass analysis revealed that only about two-thirds of the total body sodium content exchanged readily with radiosodium. Only a few attempts have been made to partition the total body content between the skeletal and nonskeletal tissues. In man, the skeleton contains 32 to 44% of total body sodium; in monkeys, 55%; in dogs and rabbits, 39 to 44%; and in rats, 21%. Data are tabulated for relation of bone sodium content to age, effect of marrow on analytical values, comparison of cortical and cancellous, sodium content of ancient bone, sodium content of cartilage, radiosodium exchange in bone and cartilage, and net change in bone sodium content. (B.O.G.)

2421 DETERMINATION OF THE CONTENT OF IRON INCLUDED INTO ERYTHROCYTES WITH THE AID OF GAMMA-RADIATION OF Fe^{59}. I. G. Akoev. Med. Radiol. 5, No. 9, 63-7(1960) Sept. (In Russian)

A description is given of the technique of determining the content of iron included into erythrocytes by measuring gamma-radiation of Fe^{59}. The method includes the preliminary preparation of the animals, dose control of the preparation, taking of blood samples on the 4th day following introduction of the isotope, single-stage washing of erythrocytes from the plasma, and assessment of the results of investigations by the absolute quantity of assimilated labeled iron (Fe-carrier). For the calculation of gamma-activity of the erythrocytic mass a scintillation device was elaborated. An assessment is made of the degree of labeled iron accumulation in healthy dogs and rats. The influence of the carrier on the rate of labeled iron inclusion is demonstrated. (auth)

2422 PHARMACOLOGICAL EFFECT OF MERKAMINE (β-MERCAPTOETHYLAMINE). G. T. Chernenko. Trudy Vsesoyuz. Konf. Med. Radiol., 77-81(1957). (In Russian)

Merkamine (1:20 to 1:50) causes an acceleration of movement followed by a cessation of movement in the simplest type of organisms (Paramecium, Candatum, Opalina, and Ranarum). A concentration of 1:100 to 1:200 causes cessation of movement in 41 to 43 min. The toxic dose of merkamine is 900 mg/kg for frogs, 200 mg/kg for white mice, 150 mg/kg for rats, and 75 mg/kg for dogs. The animal is in an excited state for 5 to 10 min with an accelerated respiration. Then a profound depression sets in. Death at lethal doses is due to paralysis of the respiratory system. Merkamine does not cause abortion or death of the fetus in pregnant rats and cats. At doses of 300 to 900 mg/kg frogs pass into a deep depression in 60 to 70 min and do not respond to the irritating action of 0.25% HCl on their hind legs. At protective doses (100 mg/kg) merkamine has an antidiuretic action (5.9% and 18% of excess liquid eliminated at 2 and 5 hr after intake compared with 61.5 and 75%, respectively, in the control rats). Injection of a 10% merkamine solution results in a local irritating action. At a dose of 65 to 75 mg/kg merkamine causes a slight temporary fall in blood pressure accompanied by increase in respiration in dogs. At a dose of 100 to 130 mg/kg there is a large drop in blood pressure and the dog dies as a result of paralysis of the respiratory center. (TTT)

Fallout and Ecology

2423 RADIO-CHEMICAL ANALYSIS OF THE LIVERS OF FISHES CAUGHT IN THE PACIFIC OCEAN IN 1958. Kakuma Nagasawa, Yoshiko Kasida, and Yasumasa Kido (National Hygienic Lab., [Japan]). Bunseki Kagaku 9, 310-16(1960). (In Japanese)

The ashes of the livers of fishes caught in the Pacific Ocean in 1958 were analyzed for their radio contamination by the ion exchange and precipitation methods. As a result, some radio nuclides, Fe^{59}, Zn^{65}, Cd^{115m}, and $Sr^{90} + Y^{90}$ were identified with the measurements of their half-lives, absorptions, and energies. The maximum concentrations of the elements determined were Fe^{59}, 4.0×10^{-3} μc; Zn^{65}, 4.0×10^{-1} μc; Cd^{115m}, 6.3×10^{-3} μc; and $Sr^{90} + Y^{90}$, 2.5×10^{-6} μc. (auth)

2424 UPTAKE OF Sr^{85} AND Ca^{45} THROUGH EPITHELIA OF FRESH-WATER AND SEA-WATER ADAPTED TILAPIA MOSSAMBICA. Della F. Reid, Sidney J. Townsley, and Winifred T. Ego (Univ. of Hawaii, Honolulu). Proc. Hawaiian Acad. Sci., 34th Ann. Meeting, 1958-1959 1p.[(1959)].

In a series of experiments, using the euryhaline cichlid, Tilapia mossambica, the rate of movement of Ca^{45} and Sr^{85} through various epithelia was measured. It was found that the skin of the body of Tilapia is only slightly less permeable than that of the gills. The rate of movement of calcium and strontium in fresh-water-adapted Tilapia is about one-third the rate of transfer of the same ions when the fish are adapted to sea water. The urine excreted by the fresh-water-adapted individuals contains less calcium and strontium than is contained in their blood; whereas, in the urine excreted by the salt-water-adapted fish the concentration is the same as in the blood. When these fish are transferred from fresh water to sea water, the rate of excretion of urine falls from ~12 ml per 24 hr to ~3 ml for the same period. The fish in fresh water swallow almost no water; whereas they swallow as much as 15 ml for the same period when placed in sea water. These results prove the value of the technique and indicate the ability to formulate a valid picture of the hydromineral regulation in Tilapia when the several ions contained in their environment are studied. (auth)

Radiation Effects on Living Tissues

2425 (A/AC.82/G/R.205) NATURE OF THE INITIAL EFFECT OF RADIATION ON THE HEREDITARY STRUCTURES. N. P. Dubinin, ed. Akademiya Nauk S.S.S.R. 1958. 40p.

The processes involved in radiogenetic changes in cells are discussed. Problems of radiation genetics are reviewed. Results are summarized from a number of recent studies and various theories of the nature of the action of radiation are evaluated. It is concluded that the role of long-lived states of excitation in chromosomes, proteins, and other biological systems should be studied further. 173 references. (C.H.)

2426 (AMRL-445) IMMEDIATE REACTION TO X-IRRADIATION OF THE RED-EARED TURTLE (PSEUDEMYS SCRIPTA ELEGANS). A. T. Krebs. Army Medical Research Lab., Fort Knox, Ky. Oct. 12, 1960. 12p. USAMRL Project No. 6X64-14-001-01.

Red-eared turtles exposed to 50 kv x rays respond nearly immediately and in a characteristic way to the irradiation. Several seconds after start of the irradiation the animal responds to the new factor in its environment by characteristic movements and turning of its head. The first movement is followed some seconds later by a sudden decisive move of the animal out of the x-ray beam. The reaction time decreases with increasing number of tests, goes through a broad minimum and reaches, with 15 to 20 test exposures, values nearly twice as high as the starting ones. The dose-response curve shows great similarity with the dose response found in the dark adapted horseshoe crab (Limulus polyphemus). Possible mechanisms of the effect are discussed. (auth)

2427 (AMRL-449) ORGAN WEIGHT CHANGES IN CHEMICALLY PROTECTED AND NON-PROTECTED X-IRRADIATED RATS. R. I. H. Wang and James G. Kereiakes. Army Medical Research Lab., Fort Knox, Ky. Oct. 19, 1960. 11p. USAMRL Project No. 6X64-14-001-04.

Using an effective chemical mixture of 200 μM MEA and 7.5 μM serotonin per rat, a 100% survival of the protected rats exposed to a $LD_{100/30}$ dose of 900-r whole-body x radiation was obtained. Following the radiation exposure, decreases in intestinal and splenic weights among the protected rats were found to be much less than that of the nonprotected rats. These differences in organ weights on the third postradiation day for the spleens and on the second to fourth day for the small intestines are not only statistically significant but probably account adequately for the survival of the chemically protected rats from the lethal effect of 900-r whole-body radiation. (auth)

2428 (NP-9245) THE LETHAL DOSE OF TOTAL BODY X-RAY IRRADIATION IN SWINE. Report No. 3. John L. Tullis, Carl F. Tessmer, Eugene P. Cronkite, and F. W. Chambers, Jr. Naval Medical Research Inst., Bethesda, Md. Dec. 22, 1947. 11p. Project No. NM-007 039.

For correlation with radiation-injury data obtained at Bikini, experiments were conducted on the x-ray dose for whole-body exposure of swine to kill 50% of exposed animals within 30 days ($LD_{50/30}$). Groups of eight (four male and four female) healthy hybrid swine were exposed using a 1000-kv 3-ma machine. A value of 275 r was obtained. (T.R.H.)

2429 (NP-9301) DOSES TO THE GASTROINTESTINAL TRACT FROM INGESTION OF FISSION PRODUCTS IN DRINKING WATER OR FOOD. U. Greitz. Sweden. Försvarets Forskingsanstalt, Stockholm. Aug. 1960. 22p.

The characteristics of the gastrointestinal (GI) tract are reviewed, and a description is given of a procedure for calculating the dose received by the GI tract from ingested radioisotopes. Fission products with Np^{239} added were used, and consumption periods likely to be encountered in military emergencies were chosen. Some consideration was also given to the genetic dose received by γ irradiation of the gonads as ingested activity moves through the GI tract. (T.R.H.)

2430 (NYO-9342) A COMPARISON OF THE FINE STRUCTURE OF THE NORMAL AND THE IRRADIATED LENS. Final Report [for] period May 1, 1955–August 31, 1960. Marie A. Jakus. Retina Foundation, Boston. Nov. 1, 1960. 14p. Contract AT(30-1)-1789. OTS.

Thin sections of lenses were made and examined with the electron microscope to study the structure of normal lenses and the early effects of radiation. The study dealt mainly with the fine structure of the peripheral lens, the lens epithelium, the lens capsule, and zonular fibers of various species. No consistent results were obtained from examination of irradiated lenses, and the irradiation factors were not available for correlation. Lens histogenesis is discussed. (T.R.H.)

2431 (TID-6868) STUDIES ON CHEMICAL PROTECTION AGAINST RADIATION-INDUCED INTESTINAL INJURY. Period covered: June 1, 1959–July 1, 1960. Emanuel E. Schwartz and Bernard Shapiro. Albert Einstein Medical Center, Philadelphia. Oct. 21, 1960. 22p. Contract AT(30-1)-2406. OTS.

Whole body x irradiation with 600r and higher doses caused impairment in the absorption of iodinated oleic acid in mice 2 days after exposure. Diminution in I^{131}–labeled serum albumin absorption was not observed even after 1400 r. Although irradiation also caused increased gastric retention, this was apparently not responsible for the decrease in fatty acid absorption. 2-mercaptoethylguanidine administered before irradiation, either orally or intraperitoneally, largely prevented the deleterious effect on absorption and gastric emptying. The significance of this functional impairment by irradiation and the preservation of life and function by chemical radioprotective agents is discussed. (auth)

2432 (USNRDL-TR-457) EFFECTS OF CATIONS AND OF X-RADIATION ON IN VITRO ENZYMATIC SYNTHESIS OF DEOXYRIBONUCLEIC ACID. E. R. Walwick and R. K. Main. Naval Radiological Defense Lab., San Francisco. Sept. 2, 1960. 22p.

In a soluble multienzyme system derived from rat thymus, various cations were studied with respect to their effects on the rate of DNA synthesis; energy was supplied by several different sources. DNA synthesis was followed by measuring tritiated thymidine incorporation. Inhibition of DNA synthesis was observed with monovalent cations and calcium when ATP was employed as sole energy source. With energy supplied by phosphoenolpyruvate, potassium > cyclohexylammonium > sodium ions were stimulatory. Calcium was stimulatory with creatine phosphate as energy source. These findings reflect the known cation requirements of pyruvic kinase and creatine kinase. During a 5-hr incubation period, while this DNA-synthesizing system was exposed to 10,000 r x radiation delivered during the initial 40 min, no effect on the rate of DNA synthesis was detected. No rate changes were caused by intermediate x-ray doses delivered during a 1-hr incubation period. Under these ex-

perimental conditions the kinases and polymerases for DNA synthesis, the DNA primer, and the glycolytic enzymes of the energy supplying system employed were unaffected by x radiation. (auth)

2433 (AEC-tr-4265) EFFECT OF OXYGEN IN IONIZING RADIATION. (Kislorodnyĭ Effekt Pri Deĭstvii Ioniziruyushchikh Izluchenĭĭ). E. S. Shchepot'eva (Shchepot'yeva), S. N. Ardashnikov, G. E. Lur'ye, and T. B. Rakhmanova. Translated from a publication of the State Publishing House for Medical Literature, Moscow, 1959. 161p. OTS.

A review is presented on the role of oxygen in radiation effects. Separate sections are devoted to radiations of high and low ionization density, special features in O_2 effect such as radiosensitivity, use of the O_2 effect in study of radiobiological mechanisms, and "exceptions" to the O_2 effect. (213 references). (T.R.H.)

2434 (JPRS-2414) EXCERPTS FROM AZERBAIDZHAN MEDICAL JOURNAL. Translation of Azerbaidzhan. Med. Zhur. No. 12, p.10-13; 64-6(1959). 9p. OTS.

Six rabbits were used in a study of the effect of a single radiation dose on the eye. A 450-r dose was applied in 20 min and the eyes examined by various instruments. The results showed that corneal sensitivity is affected in a regular manner. The data agree with that found in the literature. (T.R.H.)

2435 (JPRS-2706(p.1-7)) CHANGES IN THE CONDITIONED REFLEX ACTIVITY OF THE OFFSPRING OF DOGS WHICH HAVE BEEN SUBJECTED TO CHRONIC IRRADIATION WITH Sr^{90}. V. A. Nazarov. Translated from Med. Radiol. 4, No. 9, 13-17(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 1369.

2436 (JPRS-2706(p.16-36)) THE EFFECT OF Po^{210} ON THE BODY. B. B. Moroz and N. P. Smirnova. Translated from Med. Radiol. 4, No. 9, 66-74(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 1374.

2437 (JPRS-2706(37-9)) THE EFFECT OF TOTAL-BODY X-IRRADIATION ON THE EXCRETION OF SUBSTANCES DETERMINABLE BY THE DISCHE REACTION IN THE URINE. (A Preliminary Report). N. A. Fedorov. Translated from Med. Radiol. 4, No. 9, 75-6(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 1375.

2438 (JPRS-2706(40-2)) DISTURBANCE AND RECOVERY OF THE SECRETORY FUNCTION OF THE GASTROINTESTINAL TRACT. M. F. Nesterin. Translated from Med. Radiol. 4, No. 9, p.76-7(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 1376.

2439 (JPRS-2926) IONIZING RADIATION AND PROBLEMS OF BONE MARROW TRANSPLANTATION. A. S. Shevelev. Translated from Patol. Fiziol. i Eksptl'. Terap. 4, No. 1, 3-13(1960). 29p. OTS.

The effects of irradiation on the "take" of transplanted hematopoietic tissue are discussed. The literature on the subject is reviewed and conclusions are presented. 146 references. (C.H.)

2440 (JPRS-2929) THE EFFECT OF DIFFERENT DOSES OF X-IRRADIATION ON THE CORTICOSTEROID SECRETION IN RABBITS. V. M. Rodionov, L. O. Orlova, and L. I. Tuul'. Translated from Patol. Fiziol. i Eksptl. Terap. 4, No. 1, 24-8(1960). 12p. OTS.

In the irradiation of rabbits with increasing doses of x rays the rate of secretion of the various corticosteroids is changed differently; the rate of secretion of the corticosterone is essentially unchanged; the rate of secretion of hydrocortisone is increased; the rate of secretion of compound-X increases with irradiation of the animal with 800 to 1000 r and decreases with further increase in the irradiation dose. (auth)

2441 (JPRS-2930) THE CHARACTERISTICS OF THE LOCAL (SKIN) REACTION IN THE OFFSPRING OF IRRADIATED DOGS. A. P. Novikova. Translated from Patol. Fiziol. i Eksptl. Terap. 4, No. 1, 28-32(1960). 13p. OTS.

Chlorvinyldichlorarsine in doses of 0.2 and 1 mg/square centimeter produced a more severe injury of blood vessels of the superficial and deep systems in the offspring of irradiated dogs than in the control animals. The course of the chemical skin burns produced by this substance in young dogs of injured parents is different from the normal course in the following characteristics: the early appearance of signs of inflammation, injury to the deeper layers of the skin, delayed formation of granulation tissue, and later healing. (auth)

2442 (JPRS-2936) CHANGES IN THE MORPHOLOGICAL COMPOSITION OF THE PERIPHERAL BLOOD OF DOGS OF VARIOUS HIGHER NERVOUS ACTIVITY TYPES UNDER THE INFLUENCE OF CHRONIC IRRADIATION WITH SMALL DOSES OF GAMMA RAYS (Co^{60}). O. F. Makarchenko, M. F. Sirotina, and R. S. Zlatin. Translated from Fiziol. Zhur., Akad. Nauk Ukr. R.S.R. 5, 769-73(1959). 11p. OTS.

Systematic observations of the morphologic composition of the blood during the period of one year in dogs subjected to total external irradiation with small doses of γ rays from radioactive cobalt indicate that the changes in the hematologic indexes are characterized by great lability. Especially pronounced was the polycythemic reaction which was seen in the majority of the investigated animals during the period from the fifth to the ninth month after onset of radiation. At the same time there was a marked increase in the number of thrombocytes. The results of these observations afford some basis for assuming that in animals of the strong type of higher nervous activity, during certain periods of exposure to penetrating radiation, changes in the morphologic composition of the blood are different from those seen in animals of the weak type. During the course of the year no degenerative changes were seen in the morphologic components of the peripheral blood in the experimental animals. (auth)

2443 (JPRS-5023) THE USE OF ULTRAVIOLET RADIATION OF DIFFERENT SPECTRAL COMPOSITION FOR REDUCING THE SEQUELS OF RADIATION INJURY. T. A. Sviderskaya, E. (Ye.) G. Zhuk, and I. N. Filipson. Translated from Gigiena. i Sanit. 25, No. 2, 27-33(1960). 14p. OTS.

Experiments on guinea pigs demonstrated that prophylactic use of ultraviolet rays increases the resistance of the organism to the effect of lethal doses (450 r) of γ radiation. In animals subjected to prophylactic irradiation with ultraviolet radiation, there is an increase in the survival rate; a considerably lesser reduction in the number of leucocytes, hemoglobin content, and cholinesterase activity; a lesser reduction of work capacity; and accelerated and more complete reparation processes. In the mobilization of the defense mechanisms which are at the base of the prophylactic action of ultraviolet radiation, the spectral composition and size of the total dose of ultra-

violet radiation, the length of time interval between the actions of both agents on the organism, and the method of ultraviolet irradiation are of substantial importance. The size of the optimum prophylactic dose of ultraviolet radiation depends on its spectral composition. Upon the increase of the total dose of erythemic radiation from 7.5 to 15 biodoses, the prophylactic effect of ultraviolet rays increases, whereas the increase of the total radiation dose of PRK-2 lamp (from 3.75 to 15 biodoses) and bactericidal lamps from 7.5 to 15 biodoses leads to the reduction of the prophylactic effect. In the comparative evaluation of the prophylactic effect of ultraviolet radiation of various spectral composition used in equal biological doses, the long-wave radiation of the EUV lamp and the integral stream of the PRK-2 burner possess a greater protective effect than the short-wave rays of the BUV lamp. Equal total doses of ultraviolet radiation exert a different protective effect, depending on the size of the time interval between the end of ultraviolet irradiation and the subsequent action of γ rays. The results of prophylactic irradiation were better at a 14-day interval than at an interval of 9 days. The method of carrying out the prophylactic irradiation has a definite effect on the final result. The PRK-lamp radiation exerts a greater protective effect when the animals are irradiated with equal nonerythemic doses and not with progressively higher doses. The data cited in this work attest to the fact that, under definite conditions, ultraviolet rays may be used for the purpose of increasing the resistance of the organism to penetrating radiation. (auth

2444 (JPRS-5107) EFFECT OF Y^{90} ON THE NERVOUS SYSTEM IN CONNECTION WITH THE POSSIBILITY OF USING IT IN EXPERIMENT AND IN THE NEUROSURGICAL CLINIC. A. V. Lebedinskiĭ (Lebedinskiy), L. D. Klimovskaya, Z. N. Nakhil'nitskaya, V. V. Sedov, and N. P. Smirnova. Translated from Voprosy Neirokhirurgii 24, No. 2, 9-12(1960). 9p. OTS.

Yttrium-90 was introduced into the hypophysis of rabbits in the form of ceramic or metallic rods by means of a regular injection needle. The hypophysis was approached through the mouth. The position of the yttrium rod was checked roentgenographically in two projections. All animals were then subjected to a systematic clinical examination. Measurements were made of body temperature, electrocardiogram recordings, respiratory movements, and size of pupils. Neurological symptoms and the permeability of vessels of the ciliary tract were also studied. An analysis of data led to the conclusion that Y^{90} depresses hypophyseal function and also causes brief periods of stimulation of secretory activity. (C.H.)

2445 (JPRS-5177) THE CHANGE IN THE ACTIVITY OF THE ENDOCRINE GLANDS IN EXPERIMENTAL RADIATION PATHOLOGY. P. D. Gorizontov and T. N. Protasova. Translated from Arkh. Patol. 22, No. 4, 3-14 (1960). 24p. OTS.

Results are reviewed from a number of studies on the effects of radiation on activity of endocrine glands. Topics discussed include the effects of irradiation on the secretion of adrenal and pituitary hormones, the activity of the sex glands, the activity of the thyroid gland, and the influence of the endocrine system on certain processes in the presence of radiation sickness. 129 references. (C.H.)

2446 (JPRS-5194) CHARACTERISTICS OF THE REACTION OF THE GASTROINTESTINAL TRACT TO CHEMICAL STIMULATION UNDER CONDITIONS OF INJURY OF THE ORGANISM DUE TO RADIOACTIVE STRONTIUM. G. A. Lebedeva. Translated from Arkh. Patol. 22, No. 4, 21-8(1960). 13p. OTS.

The reaction of the mucous membrane of the gastrointestinal tract to chemical stimulation in the presence of the intraperitoneal administration of Sr^{90} is characterized by a number of peculiarities: (1) in the presence of the action of a chemical stimulant a raised vulnerability of the tissues is observed; (2) all phases of the course of the inflammatory process are considerably drawn out in time; (3) a retardation and sometimes a distortion of the regenerative process are noted. The changes detected attest to a lowering of the reactivity of the gastrointestinal tract under conditions of injury of the organism due to Sr^{90}. (auth)

2447 (JPRS-5493) DATA ON THE RADIOSENSITIVITY OF CERTAIN AGRICULTURAL PLANTS. S. A. Valeva. Translated from Biofizika 5, 244-8(1960). 10p. OTS.

A summary table is presented on the radiosensitivity of the seeds of a number of agricultural plants. The table was prepared to facilitate the selection of radiation doses for seeds during radiation genetic studies on plants. (C.H.)

2448 (JPRS-5769) RADIATION BURNS. (Luchevyye Ozhogi). V. A. Polyakov. Translated from Khirurgiya 26, No. 6, 98-104(1960). 24p. OTS.

Four case histories of local burns by ionizing radiation are reviewed, and recommendations are given for treatment of first, second, and third degree burns. It is concluded that burns should be defined as an injury to tissues by high temperatures, chemicals, or radiations. For third-degree radiation burns, early and radical removal with plastic coverage is recommended. Recommendations concerning safety in radiotherapy are also given. (T.R.H.)

2449 (JPRS-6175) THE EFFECT OF IONIZING RADIATIONS ON THE HUMAN ORGANISM. Witold Zawadowski. Translated from Polski Tygodnik Lekarski 15, No. 8, 3-15(1960). 10p. OTS.

The literature on the biological effects of radiation on man is reviewed. The danger threatening hereditary characteristics and the possibility of an increase of the number of development defects induced by radiation are discussed. (C.H.)

2450 (JPRS-L-833-N) ELECTROENCEPHALOGRAPHIC ANALYSIS OF CERTAIN REMOTE SEQUELAE OF THE ACTION OF IONIZING RADIATION IN THE ANTENATAL PERIOD OF DEVELOPMENT. A. M. Ivanitskiĭ (Ivanitskiy). Translated from Patol. Fiziol. i Eksptl'. Terap. 3, No. 1, 21-6(1959). 12p. OTS.

The electroencephalograms (EEG) of adult rabbits irradiated on the 23rd day of embryonic development are characterized by a reduction in the voltage of the curves with preferential damage to the upper ranges of frequency of the EEG spectrum. Studies of curves of reactivity of the EEG indicate a reduction in excitability and reactivity of the EEG and an increase in the after-effects in the experimental animals; the presence of the phenomenon of paradoxicality was with much greater frequency among the experimental animals, than among the normals. These features of the EEG testify to a reduction in the functional properties of the nervous system of experimental animals, which indicates the high sensitivity of the embryonic nervous system to radiation effects. The consequences of irradiation are stable and prolonged. (auth)

2451 INTERMITTENT RADIATION AND THE LIFE SPAN OF MICE. James T. Duhig and Shields Warren (New England Deaconess Hospital, Boston). A.M.A. Arch. Pathol. 70, 486-96(1960). (AECU-4592)

It is suggested that recently developed theoretical treatments of life-span data by the use of the same or similar concepts may be useful in defining curves that may allow

more confident extrapolation from one species to another. It may then be possible to limit the very large scale experiments requiring many animals that would be necessary to define accurately the effects of very small doses of radiation on man. Fractionation of dosages with weekly recovery times in mice resulted in a shortening of the life span that was equivalent to that produced by smaller daily doses when similar total doses were given. The modes of death were quite different from those seen when the same total doses were delivered acutely. 32 references. (auth)

2452 LESIONS IN THE DEPTH OF THE BRAIN PRODUCED BY A BEAM OF HIGH ENERGY PROTONS. Lars Leksell, Börje Larsson, Bengt Andersson, Bror Rexed, Patrick Sourander, and William Mair (Uppsala Univ.). Acta Radiol. 54, 251-64(1960) Oct. (In English)

Restricted lesions were produced in the depth of the goat's brain by means of cross-fire irradiation with a narrow beam of high-energy protons. The radiosurgical technique and the histopathology of the lesions are described. It was possible to produce circumscribed cerebral lesions of a type well suited for physiologic experimentation without damaging surrounding nervous tissue. The method may also be applied to neurosurgery in man. (auth)

2453 RADIOGRAPHIC APPEARANCES OF BONE LESIONS IN RATS EXPOSED TO LOCAL EXTERNAL IRRADIATION FROM GAMMA RAYS. D. B. Cater, R. Baserga, and H. Lisco (Cambridge Univ., Eng.; Northwestern Univ., Chicago; and Argonne National Lab., Ill.). Acta Radiol. 54, 273-88(1960) Oct. (In English)

The development of bone lesions was followed radiographically after a single dose of 3000 r γ rays from an Ir^{192} source applied to both knees of 136 rats. Stunted growth of bone was the earliest detectable change. At 6 months, zones of osteolysis and osteosclerosis were frequent. Transverse bars of bone, pathologic fractures, and destruction of bone were also seen; some lesions persisted, others healed. Epiphyseal cartilages were thickened in 100% and doubled in 25% of irradiated rats. Osteosarcomata developed in 34 out of 116 rats surviving more than 250 days. (auth)

2454 THE RESISTANCE TO γ RADIATION OF THE WORKER BEE. G. Courtois and J. Lecomte (Centre d'Études Nucléaires, Saclay, France). Ann. abeille 4, 285-90(1959). (In French). (CEA-1377)

The worker bee which has been subjected to γ radiation from a Co^{60} source can withstand without apparent physical damage a dose of 18,000 r. At 90,000 r there is, however, appreciable damage. At a dose of 200,000 r, death is immediate in 100% of the cases. The physiological state of the bee plays an important role in determining its resistance to γ radiation. (auth)

2455 IRRADIATION OF DIPHOSPHOPYRIDINE NUCLEOTIDE IN DILUTE AQUEOUS SOLUTIONS. D. K. Myers. Can. J. Biochem and Physiol. 38, No. 11, 1255-63(1960) Nov.

In the extension of previous in vivo experiments, the effects of x rays on DPN were studied in vitro. No correlation between the effects on the ultraviolet absorption spectrum and on the coenzyme function of DPN was evident after irradiation at different pH values. The loss of the coenzyme function could be correlated with the destruction of ribose and riboside linkages. Catalase did not provide greater protection than did other proteins. It was concluded that the observed loss of DPN from irradiated cells is not due to the radiosensitivity of the DPN molecule itself. (auth)

2456 MODIFICATION OF RADIATION INDUCED DAMAGE IN BARLEY SEEDS BY THERMAL ENERGY. C. F. Konzak, H. J. Curtis, N. Delihas, and R. A. Nilan (Washington State Univ., Pullman and Brookhaven National Lab., Upton, N. Y.). Can. J. Genet. and Cytol. 2, No. 2, 129-41(1960) June.

By freezing seeds of barley, Hordeum vulgare, in dry ice at −78°C, development of increased damage in post-radiation storage was inhibited. Frozen irradiated seeds responded to subsequent storage at 23°C the same as newly irradiated seed. Preradiation heat treatments of dry seeds reduced observed injury but postradiation heat treatments increased injury. Germination temperature was found to be an important factor determining the level of radiation-induced injury expressed by seeds. Germination at 27°C was conducive to lower damage, whereas germination at 20°C or lower seemed to favor greater damage. The period of temperature influence on observed injury appeared to be limited, possibly to the duration of the first mitosis in the embryo. Short duration (60 sec) 60°C heat shocks on seeds with approximately 16% embryo moisture served not only to reduce injury, measured as seedling height, but also to reduce the frequency of induced chromosome fragments in shoot-tips from irradiated seeds. The results appear to coincide with those obtained following irradiation of biologically important macromolecules such as cellulose, plastics, and DNA. The findings tend to support the thesis that under certain conditions radiation-activated or excited states may mediate a larger or smaller proportion of the total cell damage induced by x radiation. (auth)

2457 LATENT INJURY AND REPAIR IN RAT LIVER INDUCED TO REGENERATE AT INTERVALS AFTER X-RADIATION. Mary D. Albert and Nancy L. R. Bucher (Harvard Univ., Boston). Cancer Research 20, 1514-22 (1960) Nov.

When young adult male rats were exposed to a single dose of x radiation of 365 or 600 r to the whole body and were partially hepatectomized immediately afterward, the regenerating livers exhibited a lag in initiating both DNA synthesis and mitosis. The lag was most pronounced in livers that had been regenerating for 27 hr, a time when controls exhibited near maximal levels of activity. When days elapsed between irradiation and the induction of hepatic regeneration, the lag gradually diminished so that after 8 weeks the response of the irradiated animals was similar to that of the controls. When a second partial hepatectomy was performed 4 or 5 days after the first, recovery from the above effects of irradiation was expedited. The number of chromosome bridges and other signs of structural damage resulting from irradiation did not diminish with time under any of the above conditions; thus it appears that certain functions, although presumably inactive at the time, are impaired by x radiation administered when cells are in the nondividing state, but the recovery is accelerated by induction of cell proliferation. Other functions, involving the distribution of genetic material, appear to be more permanently damaged. (auth)

2458 THE INFLUENCE OF CARBON DIOXIDE ON TRADESCANTIA CHROMOSOME ABERRATIONS INDUCED BY RADIATIONS OF DIFFERENT ION DENSITIES. L. E. LaChance and D. M. Steffensen (Brookhaven National Lab., Upton, N. Y.). Exptl. Cell Research 20, 519-28(1960) Sept.

The influence of carbon dioxide on chromosome aberrations induced by γ rays, x rays, 14.1-Mev neutrons, and fission neutrons was studied in Tradescantia. The addition of CO_2 to air caused a significant increase in the

yield of x- and γ-ray-induced chromosome exchanges and interstitial deletions. When 14.1-Mev neutrons are used, carbon dioxide has a slight but significant effect. With fission neutrons CO_2 had no effect. The hypothesis is made that carbon dioxide increases aberration frequency in irradiated material by decreasing viscosity, a known effect, and thus promoting chromosome movement thereby favoring new reunions over restitution. Carbon dioxide need not be present during the irradiation to be effective provided that the irradiation in air immediately follows the pretreatment. (auth)

2459 EFFECT OF RADIATION ON BONE MARROW CELLS AT VARIOUS TEMPERATURES IN VITRO. V. Drášil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folio Biol. (Prague) 6, 359-64(1960). (In English)

Mouse bone marrow was irradiated in vitro with x-ray doses from 500 to 4000 r. Irradiation was carried out at temperatures of 20, −78.4, and −192°C. The cell viability after irradiation was determined according to the ability of bone-marrow cells to colonize the spleen of an irradiated mouse, thus inducing growth of spleen weight. The results of the experiments showed that the sensitivity of bone marrow to irradiation is altered very slightly with a decrease in temperature. It is therefore suggested that the direct effect of ionization and excitation in sensitive cell structures is the primary cause of radiation damage to bone marrow. (auth)

2460 CHANGES IN THE CATALASE ACTIVITY OF THE LIVER IN MICE AFTER X-IRRADIATION. M. Praslička and Pavla Žáčková (Safárik Univ., Košice, Czechoslovakia and Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague) 6, 379-82(1960). (In English)

Experiments were performed on catalase activity in livers of irradiated female white mice. The mice, which were fed a Larsen diet, were irradiated at 180 kv, 15 ma at 66 r/min to total-body doses of 600, 720, and 1000 r. The mice were decapitated and exsanguinated at various stages, and livers were removed and analyzed for catalase activity by a manganometric titration for undecomposed H_2O_2. After 600 r no significant reduction in catalase activity occurred until the second day. Following irradiation by 720 and 1000 r, the activity in all mice is reduced more than for 600 r, the reduction beginning earlier for 1000 r than for 720 r. (T.R.H.)

2461 RADIATION: AN AID IN PLANT IMPROVEMENT. Seymour Shapiro (Brookhaven National Lab., Upton, N. Y.). Garden J. 10, 167-70(1960) Sept.-Oct. (BNL-4858)

At Brookhaven National Laboratory, a cooperative program was established in 1952 to enable plant breeders and agriculturists in the United States to make use of a broad spectrum of radiation techniques in plant-improvement programs. Seeds and cuttings are generally exposed to thermal neutrons in the reactor or to x-rays using a conventional x-ray machine. Growing plants are exposed for various periods in a 10-acre radiation field using a 2000-c Co^{60} γ source. The ways in which radiation causes mutations are discussed. The results of radiation experiments on mutations in various types of plants are described. Many potentially useful mutations are undergoing extensive testing and evaluation. (B.O.G.)

2462 STUDIES ON THE RADIATION INACTIVATION OF MICROORGANISMS. VI. X-RAY-INDUCED BREAKDOWN OF DEOXYRIBONUCLEIC ACID IN HAEMOPHILUS INFLUENZAE AND IN OTHER BACTERIA. Johan H. Stuy (Oak Ridge National Lab., Tenn.). J. Bacteriol. 79, 707-15(1960) May.

Results are reported from a study of the inactivation of Haemophilus influenzae by exposure to x radiation. Measurements were made of the formation of desoxyribonucleic acid in the bacteria before and after irradiation. Data are compared with those from a study of the effects of ultraviolet inactivation. (C.H.)

2463 AN X-RAY INDUCED BLOCK PREVENTING CELL DEGENERATION AND ACCOMPANYING AN INHIBITION OF CELL DIVISION IN YEAST. Edward Spoerl, H. W. Nields, and J. J. Plisich (U. S. Army Medical Research Lab., Fort Knox, Ky.). J. Cellular Comp. Physiol. 56, 55-65(1960) Aug.

Growing yeast cells given a low dose of x radiation adequate to inhibit cell division were found after a period of starvation to be more viable and also more capable of taking up P^{32} and oxygen and producing carbon dioxide than were unirradiated cells. The possibility was discussed that the action of radiation was somehow to stabilize the cell membrane or a component structure and thus preserve these capacities through the period of starvation, as well as prevent a loss of phosphorus and nitrogen compounds such as occurred from unirradiated cells. The starvation responses occurred in young cells, but not in old cells. In addition, a reduced potassium retentivity and rate of endogenous respiration were observed immediately after irradiation. (auth)

2464 IRRADIATION DAMAGE TO ANIMALS AND ITS EFFECT ON THEIR REPRODUCTIVE CAPACITY. E. F. Oakberg (Oak Ridge National Lab., Tenn.). J. Dairy Sci. 43, Suppl., 54-67(1960) Apr.

Adult male animals given an acute dose of radiation of several hundred roentgens are initially fertile owing to utilization of gametes irradiated as spermatozoa, spermatids, and possibly spermatocytes; become temporarily sterile owing to oligospermia resulting from killing of spermatogonia, and regain fertility as the seminiferous epithelium is regenerated from surviving spermatogonia. Details of the response of different cell stages in the seminiferous epithelium are outlined for the mouse; there is a good indication that this general pattern of response is typical for males of those species in which all stages of spermatogenesis occur in the adult. The differences between males and females in post-irradiation fertility can be traced to differences in normal gametogenesis (i.e., to the determination of the definitive number of oocytes before birth of the female mammal). In the mouse and rat, oocytes in the earliest follicle stages are sensitive to radiation, whereas those in mature follicles are quite resistant. Thus, after 50 r female mice have about four litters, then are permanently sterile; at least one litter is obtained after 400 r. It is, therefore, imperative in studies of irradiated females that total reproductive performance be measured. Extension of these results to other species is hampered by the lack of information of the dynamics of oogenesis in mammals. It is likely, however, that the response of oocytes in the same meiotic prophase stage, and in follicles of comparable stage of development, will be similar in all mammals. (auth)

2465 THE EFFECT OF IRRADIATION ON REPRODUCTION BY THE HETEROGENETIC GENERATION OF STRONGYLOIDES PAPILLOSUS. I. IRRADIATION OF MALES AND FEMALES. Frank F. Katz (Univ. of Pennsylvania, Philadelphia and Brookhaven National Lab., Upton, N. Y.). J. Parasitol. 46, 383-91(1960) June.

Fourth and fifth stage male and third and fourth stage female S. papillosus were subjected to various doses of Co^{60} γ irradiation and cultured in vitro with controls of the opposite sex. Fewer offspring were produced in cultures containing irradiated males than in cultures of irradiated females. A single experiment involving several doses and one control gave a more linear picture of the effects of irradiation than individual experiments carried out at various times for different dose levels. In the former, larvae were obtained in cultures of nematodes exposed to 20 kr but not to 40, 60, 80 or 100 kr; in the latter, larvae occurred in cultures of males irradiated at 42 kr and in cultures of females exposed to 50 kr but not at the higher levels employed. With increased doses of irradiation, there was a decrease in the percentage of eggs hatching. The dominant lethal effect was observed in cultures with males exposed to 20 kr and higher doses. In cultures with irradiated females, this phenomenon was observed at 40 kr and higher levels. (auth)

2466 EFFECTS OF ALKOXYGLYCEROLS (KABY 700) ON LEUCOPENIA FOLLOWING RADIOTHERAPY. Roger Ghys (Laval Univ., Quebec). Laval méd. 30, 331-42(1960) Oct. (In French)

A well-conducted irradiation provokes only occasional leukopenia of any importance. A preparation of alkoxyglycerol esters, similar to those found in insaponifiable lipid extracts of bone marrow, was tested on 15 patients whose leukocytosis, normal at the beginning, fell below 5000/mm^3 during radiotherapeutic treatment. This medication had the property of rapidly curing radioinduced leukopenia. Four patients could not tolerate the medication, and in seven other cases no effect was noted. In four additional cases leukocytosis was increased, but this increase could be attributed to the medication in only two of these cases. (tr-auth)

2467 CHANGES IN THE NERVOUS APPARATUS OF THE THYROID GLAND FOLLOWING ADMINISTRATION OF I^{131} INTO AN ANIMAL ORGANISM. G. N. Lychevko (Kazan State Medical Inst., [USSR]). Med. Radiol. 5, No. 9, 19-22(1960) Sept. (In Russian)

Radioiodine provokes changes in the nervous apparatus of the thyroid gland. All its elements react similarly. Preganglionic medullated fibers of the gland's efferent path are subject to fragmentation and granular decomposition. Postganglionic nonmedullated vegetative conductors are affected by the radioactive preparation at later periods, which is manifested by the formation of varicose swellings along their path. The sensitive nerve conductors display a higher resistance. Changes involve mainly the preterminal portion. (auth)

2468 REACTIVITY OF THE CARDIOVASCULAR SYSTEM OF DOGS IN CHRONIC ACTION OF LOW CONCENTRATIONS OF Sr^{90}. V. I. Korchemkin. Med. Radiol. 5, No. 9, 22-6(1960) Sept. (In Russian)

The experiments were staged on dogs subjected to chronic administration of low quantities of Sr^{90} (0.002 mc/kg, 0.02 mc/kg, and 1 mc/kg). Electrocardiographic examinations and studies of the arterial pressure changes with the employment of pharmacological loading of adrenaline and acethylcholine were performed. It was found that chronic action of low concentrations of Sr^{90} changes the functional state of the cardiovascular system. The sensitivity of the heart to adrenaline and acethylcholine rises; moreover, changes of the latter are of phase nature. Soon after the administration of strontium there is noted a prevalent tone of the parasympathetic portion of the vegetative nervous system. At late periods of affection the arterial pressure reaction to adrenaline decreases and dystrophic disorders of the myocardium may develop. (auth)

2469 RIBONUCLEOPROTEIN CHANGES IN THE MUCOSAL EPITHELIUM OF A CANINE STOMACH FOLLOWING TOTAL X-RAY IRRADIATION. A. F. Shvelnov (Kursk Medical Inst., [USSR]). Med. Radiol. 5, No. 9, 30-3 (1960) Sept. (In Russian)

The study covered dynamic ribonucleoprotein changes in the gastric mucosa of dogs, subsequent upon their total irradiation with a dose of 400 r. The animals of the first group (27 dogs) underwent irradiation after a 2-day period of fasting. Those of the second group (having the same number) were fed until complete satiation—2 hr prior to irradiation. The animals were then sacrificed within intervals of 12 hr to 30 days after irradiation. The gastric mucosa was subjected to a special treatment, to reveal ribonucleoproteins according to pertinent procedures. It was made evident that soon after irradiation the cytoplasm of basal cells and of those belonging to the upper mucous epithelium layer show a decreased ribonucleoprotein level and disturbed pattern of its distribution. These changes are more pronounced in animals subjected to fasting before irradiation. In the period of maximal decline of the ribonucleoprotein level in the cytoplasm some of the cells are destroyed. Soon after irradiation a mounting of the ribonucleoprotein content becomes apparent in the cellular nuclei. (auth)

2470 THE INFLUENCE OF LENGTHENING OR BRANCHING OF THE CARBONIC CHAIN ON THE PROTECTIVE ACTION OF β-MERCAPTOETHYLAMINE IN PENETRATING RADIATION AFFECTION. L. I. Tank. Med. Radiol. 5, No. 9, 34-8(1960) Sept. (In Russian)

The results are given of a comparison of the protective and therapeutic breadth of β-mercaptoethylamine and 6 derivatives with a lengthened and branched carbonic chain in the action of absolutely lethal dose (700 r) of filtered x rays on white mice. 1-amino-2-mercaptopropane is endowed with the most marked protective effect—it prevents the death of 90 to 100% of the irradiated animals. 1-amino-5-mercaptopentane, 1-amino-2-mercaptobutane, 1-mercapto-2-aminobutane, and 2-methyl-3-mercapto-4-aminobutane prevent the death of 50 to 60% of the irradiated animals, which approximately corresponds to the protective action of β-mercaptoethylamine. These preparations, including β-mercaptoethylamine, have a narrow therapeutic range. 3-phenyl-3-mercapto-4-aminobutane is not endowed with any protective effect. (auth)

2471 THE CONTENT OF THE NON-PROTEIN SULFHYDRYL GROUPS IN THE LIVER AND SPLEEN OF THE X-RAY IRRADIATED WHITE RATS WITH THE PREVIOUSLY ADMINISTERED CYSTEINE IN PROTECTIVE DOSES. L. S. Isupova and V. G. Yakovlev. Med. Radiol. 5, No. 9, 38-43(1960) Sept. (In Russian)

The results are presented of a study of the content of the nonprotein SH-groups in the liver and spleen of white rats soon after the total x-ray irradiation in the lethal doses. The changes of the nonprotein SH-groups content was studied in the same organs after the administration of the high protective doses of L-cysteine with the subsequent irradiation or without it. The SH-groups content in the mentioned organs was not above the limit of the biologic scattering in rats to which L-cysteine was administered. In L-cysteine treated and subsequently irradiated rats an increased rate of reduction of the SH-group content was noted in the liver and spleen soon after the irradiation. In doubling the minimal lethal dose of the irradiation almost no effect was noted on the rate of reduction of the non-

protein SH-groups in the liver and spleen of rats treated with the high L-cysteine doses. (auth)

2472 THE INFLUENCE OF HYPOTHERMIA ON THE DEVELOPMENT OF ACUTE RADIATION NECROSIS OF THE SKIN. L. A. Afrikanova, E. F. Vlasova, and E. F. Uratkov. Med. Radiol. 5, No. 9, 43-7(1960) Sept. (In Russian)

A study was made of the influence of general hypothermia on the course of radiation necrosis of the skin, developing against the background of acute radiation sickness. The experiments were staged on 150 white male rats. Acute radiation sickness was induced by whole-body x-irradiation in doses of 400 r or 250 r (180 kv, 15 ma, filter 1 mm Al + 0.5 mm Cu, KFR 40 cm). Acute radiation necrosis was provoked by local irradiation of the rat's spinal skin area with roentgen rays in doses of 5000 r (30 kv, 25 ma, filter 0.1 or 1 mm Al, KFR 10 cm) immediately after whole-body irradiation. Hypothermia was achieved by dry cooling the animals, with their complete immobility, down to rectal temperature of 25 to 23°. It is shown that in cases of combined radiation injuries there are periods in the course of radiation sickness during which hypothermia sharply aggravates the course of radiation sickness and increases the death rate of animals. Such periods are the first 3 days of the latent stage and the period of cessation of clinical manifestations of radiation sickness. The use of hypothermia during this period is inexpedient. Hypothermia exerts a positive effect on the course of radiation sickness and on that of skin lesions when it is employed at the end of the latent period (4 to 5 days following the irradiation) and at the peak of radiation sickness development. (auth)

2473 EFFECTS OF IONIZING RADIATION INJURIES ON THE PENETRABILITY OF TISSUES. P. N. Kiselev and Z. N. Nakhil'nitskaya. Med. Radiol. 5, No. 9, 73-82(1960) Sept. (In Russian)

The principal aspects of radiation pathology in tissue penetrability are reviewed, and therapeutic and prophylactic measures against radiation injuries are analyzed. A compilation of the data is made for the purpose of contributing to further studies of the reaction mechanism of tissue disturbances and pathogenesis of radiation injuries. An extensive bibliography is included. (R.V.J.)

2474 PECULIARITIES IN THE COURSE OF ACUTE CORONARY INSUFFICIENCY IN IRRADIATED ANIMALS. N. B. Ginsburg. Med. Radiol. 5, No. 9, 83(1960) Sept. (In Russian)

In tests on 80 rabbits and 20 dogs exposed to 500 and 250 r of x radiation, respectively, disturbances in breathing rhythm and development of myocardium infract were quite pronounced. Considerable enlargement of capillary vessels, hemorrhage into the heart muscle, and an enlargement of Thebesian vessels were also observed. (R.V.J.)

2475 THE RESPONSE TO GAMMA IRRADIATION IN RATS WITH DEMEDULLATED SUPRARENALS. Z. I. Barbashova and G. I. Grigor'eva. Med. Radiol. 5, 83-4 (1960) Sept. (In Russian)

The effects of adrenal cortex hormones and marrow layer hormones on reactions to ionizing radiation were compared. The removal of the marrow layer showed no effects on rat radiosensitivity. The data show that although adrenaline participates in the reaction to radiation damage, it does not influence the reaction of rats with demedullated suprarenal glands to chronic hypoxy and ionizing radiation. (R.V.J.)

2476 PHASIC CHANGES IN THE REACTIVE RESPONSES OF IRRADIATED ANIMALS WITH RESPECT TO NARCOTIC AGENTS. K. K. Poplavskiĭ. Med. Radiol. 5, No. 9, 84-5(1960) Sept. (In Russian)

The reactions of 4000 white mice, weighing 15 to 22 g, to various narcotics were studied at various stages of radiation injury induced by 360, 720, and 1440 r. The resistance of irradiated animals to narcotics and their toxic effects were not always parallel. During certain acute periods, the resistance to ether narcosis drops, while the resistance to the toxic effects increases. The data show variable reactions depending on the type of narcotic and the extent of injury. However, in acute periods the sensitivity to narcotics increases. (R.V.J.)

2477 THE INFLUENCE OF CERTAIN SUBSTANCES ON THE INTESTINE WALL PERMEABILITY TO BACTERIA IN IRRADIATED MICE. E. Z. Rukhadze. Med. Radiol. 5, No. 9, 85-6(1960) Sept. (In Russian)

Tests were carried out with mice weighing 12 to 20 g exposed to a single dose of 550 r and treated with 5 mg of citrin 2 hr and 0.1 ml of hyaluronic acid 24 hr prior to the exposure. From the day of the exposure until death, the mice were treated with 15 mg of tenalbin and 1.5 mg of tetracycline. The results show that single prophylactic treatment with citrin and hyaluronic acid does not produce significant effects on postirradiation bacteremia, combined hyaluronic acid with tetracycline reduce about three-fold the lethal effects in the animal, while combined citrin with tetracycline reduces bacteriemic effects but does not influence the outcome of the radiation injuries. (R.V.J.)

2478 THE INFLUENCE OF HYDROGEN PEROXIDE ON THE SURVIVAL RATE OF RATS AND THE CATALASE ACTIVITY IN THE PRESENCE OF IONIZING RADIATION. I. A. Pelishenko and V. V. Rudakov. Med. Radiol. 5, No. 9, 87(1960) Sept. (In Russian)

Experiments with 26 white rats exposed to 700 r, treated before exposure with several injections of hydrogen peroxide in doses much smaller than LD_{50}, showed 73% survival after 30 days while there was only 48.5% survival among 33 control animals. Tests on catalase activity under radiation effects were made on the 8th and 9th day after exposure. The tabulated data show depressed catalase activity (about 50%). Preliminary introduction of urea perhydrate increases catalase activity in healthy animals and lessens the depression of ferment activity following irradiation. (R.V.J.)

2479 ON THE FEATURES SPECIFIC TO ANTIGENIC PROPERTIES OF A PERFUSATE IN IRRADIATED TISSUES. A. G. Sverdlov. Med. Radiol. 5, No. 9, 88(1960) Sept. (In Russian)

Tests were made on rabbit ears, isolated by Ringer–Lock solution and exposed at 54 r/min to a total dosage in air of 1500 to 1600 r. The solution was administered at 22 to 24°C and 40 to 60 drops a minute. The rabbits were sensibilized by injections of perfusate with 5 to 6.5 mg protein, followed later by desensibilization with the perfusate from a second ear and the introduction of a permissible dose of antigen. The results indicate that the properties of protein antigen containing perfusate from irradiated tissue and from nonirradiated tissue differ considerably, confirming the postulation on radioinduced changes in tissue antigen properties and indicating the importance of the fluid medium on the development of autosensibilization. (R.V.J.)

2480 EXPERIENCE WITH THE PREVENTION OF THE PLACENTA RADIATION INJURIES BY EMPLOYING MERCAMINE. V. I. Bodyazhina. Med. Radiol. 5, No. 9, 88-90(1960) Sept. (In Russian)

The prophylactic properties of mercamine against radiation injury of the placenta were studied in 58 pregnant rats exposed to 200 r during the early (9 to 11 days of pregnancy) period of organological differentiation and development of principal elements of the placenta and to 300 r at a later period of organogenesis of the fetus (15 days of pregnancy). The prophylactic effect of mercamine was more pronounced in the earlier period (the period of highest radiosensitivity of the placenta). During the period of complete placenta maturity, when radiosensitivity is less acute, the effects of mercamine were less pronounced. The results suggest mercamine prophylactic action against radiation injuries in the organism of the mother and accumulation in the wall of the uterus and placenta itself. (R.V.J.)

2481 THE EFFICACY OF ANTIBIOTIC THERAPY AND OF PROPHYLACTIC EXPERIMENTAL ANTHRAX INFECTION DEVELOPING AGAINST THE BACKGROUND OF ACUTE RADIATION SICKNESS. A. P. Krasil'nikov and N. A. Izraitel. Med. Radiol. 5, No. 9, 90(1960) Sept. (In Russian)

A high index of efficiency of biomycine with streptomycin and relatively low diminishing of therapeutic activity in irradiated organism and fast immunization to anthrax infection indicate a therapeutic value of the antibiotics in anthrax infection developed during acute radiation injuries. (R.V.J.)

2482 PREVENTION OF THE LETHAL EFFECT OF THE DECAY OF INCORPORATED PHOSPHORUS-32 BY GROWTH AT 45°. Ruth F. Hill (Columbia Univ., New York). Nature 188, 412-13(1960) Oct. 29.

Inactivation of bacteria by the decay of incorporated P^{32} is reported. It is reported that the lethal chain of events may be modified after primary damage has presumably occurred. The survival of P^{32}-containing Escherichia coli B as measured by incubation at 37° and 45° is given graphically. The effects of P^{32} decay on the bacterial cell resemble the effects of x rays and ultraviolet radiation in the following particulars: prolongation of the lag, "reactivability," and the existence of a sensitive period during which "reactivation" can be obtained. Although the initial physical events are quite different for these agents, it would appear that the biological events which they trigger must have some features in common. (B.O.G.)

2483 EFFECTS OF X-IRRADIATION ON PAPILLARY MUSCLE OF THE CAT. P. Heistracher, O. Kraupp, and B. Pillat (Univ. of Vienna). Nature 188, 413-15(1960) Oct. 29.

A number of investigations were carried out previously on x-ray effects on the electrophysiological and mechanical properties of striated muscle. Only minor changes of membrane resting potential could be recorded during the first few hours following heavy x irradiation (80 to 250 kr) of frog's sartorius muscle. The membrane resting and action potentials were recorded with the intracellular microelectrode technique from papillary muscles of cats. An unfiltered x-ray source (50 kv, 25 ma) was used at dose rates of 20 and 25 kr/min at ~10 cm from the preparation for various exposures. The measurements were made at 5-min intervals for at least 1 hr before and after irradiation. The described radiation effects on heart muscle fibers resemble to some extent those obtained with 2,4-dinitrophenol or iodoacetate after incubation of rat's atrium in a solution of these substances. Woodbury reported similarities between the effects of x-rays and 2,4-dinitrophenol on striated muscle fibers. (B.O.G.)

2484 SENSITIZATION OF ESCHERICHIA COLI TO GAMMA-RADIATION BY N-ETHYLMALEIMIDE. B. A. Bridges (Wantage Radiation Lab., Harwell, Berks, Eng.). Nature 188, 415(1960) Oct. 29.

An experiment is described in which N-ethylmaleimide is shown to be a sensitization agent for Escherichia coli strain B/r. The sensitizing action could be caused by its ability to combine with –SH groups. Compounds with this property do not appear to have been reported previously as sensitizers of bacteria to irradiation under controlled gas conditions, although halogen acetates which combine with –SH groups were reported as sensitizing agents for mammals. (B.O.G.)

2485 RELATION BETWEEN X-RAY SENSITIVITY AND CELL STAGES IN MALES OF DROSOPHILA MELANOGASTER. Ruth Sävhagen (Univ. of Stockholm). Nature 188, 429-30(1960) Oct. 29.

An investigation was conducted to find the time of appearance of sperm irradiated in meiosis by a direct method and to correlate this with the sensitivity pattern. Mavor showed that irradiation of females caused primary nondisjunction. The appearance of individuals in which the paternal sex chromosomes both have entered the sperm cell indicates that the cell was treated before anaphase I. The occurrence of XO males was used as an indication of genetic damage. The induction of nondisjunction between the X and Y chromosomes in the males served as a criterion of early meiosis (prior to anaphase I). These experiments show that the treated meiotic cells become available for insemination during the seventh day after irradiation and thereafter. From this it may be concluded that the peak of sensitivity presumably corresponds to cells treated during metaphase I or before anaphase I is completed. This conclusion is supported by sensitivity studies performed on various materials. (B.O.G.)

2486 STUDIES ON THE QUANTITATIVE VARIATION OF LIPIDS IN SERUM BY THE EFFECT OF X-RAY IRRADIATION. REPORT II. EFFECTS OF TOTAL BODY IRRADIATION ON VARIOUS LIPIDS IN SERUM OF RABBITS. Hiroyuki Koike (Osaka City Univ. Medical School). Osaka Shiritsu Daigaku Igaku Zasshi 9, 2369-82(1960) July. (In Japanese)

A study was made of influences of whole-body irradiation on the quantitative variation in serum of rabbits. The rate of increase or decrease in total lipid always paralleled that of total fatty acid. In the surviving groups receiving doses of 1000 and 500 r, total lipid and fatty acid increased for 36 hr after irradiation and then gradually decreased. In the group receiving a single dose of 1000 r, the rate of increase was twice the control 36 hr after irradiation. When the same doses of total-body irradiation were repeatedly given, the rate of increase was 2.5 times the control. In the group receiving a single dose of 500 r, the rate of increase was 1.5 times the control. When the same doses were repeated, the rate of increase was twice the control. In the group which remained alive less than 30 days, the total lipid and fatty acid increased quantitatively for 36 hr after irradiation with 1000 r, followed by a slight decrease, but rose again from the third day and persisted up to death. At this time the amount was three times as much as normal. The total cholesterol decreased slightly for the first 36 hr after irradiation, but there were no significant changes. However, in the group that lived less than 30 days after irradiation with 1000 r, the total cholesterol increased for 3 days after irradiation and reached about two times the control when animals died. In the group treated with 1000 and 500 r, the total phospholipid reached the minimum about 12 hr after irradiation and returned to normal 24 hr after irradiation, but a decrease reappeared from the third day showing no recovery to normal. The

group treated with 300 r showed no significant changes in various lipids. In the fasting test, no significant changes in various lipids were observed. It was found that the quantitative variation of various lipids in serum after irradiation was not due to hunger. (auth)

2487 CHANGES IN THE SPLEEN AND LYMPHATIC GLANDS OF ANIMALS AFTER SINGLE TOTAL IRRADIATION WITH X-RAYS. N. V. Nikolaeva and N. A. Probatova (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Problems Hematol. Blood Transfusion (U.S.S.R.) (English Translation) 5, 250-6(1960).

A study was made of the changes induced by radiation in the morphology of cells from spleen and lymphatic glands of rats and dogs. Results are tabulated and illustrated with photomicrographs. (C.H.)

2488 STUDIES ON THE EFFECT OF CARBON DIOXIDE ON X-RAY INDUCED CHROMOSOME ABERRATIONS IN TRADESCANTIA. I. DURATION OF THE PRETREATMENT EFFECT. Leo E. LaChance (Brookhaven National Lab., Upton, N. Y.). Proc. Natl. Acad. Sci. U. S. 46, 1501-6(1960) Nov.

The pretreatment of Tradescantia inflorescences with one atmosphere of CO_2 plus one of air is effective in increasing the number of chromosome aberrations induced by x rays by about 1.6 times. Separating the CO_2 pretreatment and radiation by increasing periods in air has shown that the CO_2 effect persists for about 20 min. After this period the aberration frequency returns to control levels. Following the CO_2 treatment the oxygen uptake rate of the tissues is greatly increased. There is reason to believe that changes in nucleoplasmic viscosity and oxidative metabolism may alter the frequency of chromosome aberrations induced by radiation. (auth)

2489 WHOLE-BODY RADIOPROTECTION OF MICE TO 8-Mev ELECTRONS PRODUCED BY BREATHING NITROGEN FOR BRIEF PERIODS. E. A. Wright (St. Mary's Hospital, London). WITH A NOTE ON THE DOSIMETRY OF WHOLE-BODY IRRADIATION OF MICE WITH FAST ELECTRONS. D. K. Bewley (Hammersmith Hospital, London). Radiation Research 13, 649-56(1960) Nov.

The resistance of anesthetized mice to whole-body irradiation with 8-Mev electrons has been increased by a factor of between 2.3 and 2.5 during the last 5 sec of a 30-sec period of breathing pure nitrogen. (auth)

2490 SPLENIC RADIOPROTECTIVE AGENT: PARTICULATE OR DIFFUSIBLE? Roberts Rugh and Erica Grupp (Columbia Univ., New York). Radiation Research 13, 657-60(1960) Nov.

Mouse fetuses at 17.5 days are structurally quite complete and functionally quite normal, although certain parts of the brain are still in the process of development. The hematopoietic system is well organized, so that if the protective element of the spleen is diffusible and can pass through the placenta one would expect some protection. This is indirectly confirmed in another paper by Rugh and Clugston in which it was shown that cysteamine injected intraperitoneally into the pregnant mouse after exposing it to 700 r of x rays improved the survival expectancy of the offspring by 79%. Thus it is shown that, although cysteamine can penetrate the placenta and protect the fetus, such diffusible substances are not present in the spleen homogenates used in these experiments. It is concluded that the radioprotective element in the spleen is apparently related to particulates rather than to any soluble cysteamine-like substance diffusing from it. (auth)

2491 THE RADIATION SENSITIVITY OF PHYCOMYCES. INTERACTION OF VISIBLE LIGHT AND IONIZING RADIATION. A. G. Forssberg, R. Novak, G. Dreyfus, and A. Pehap (Karolinska Institutet, Stockholm). Radiation Research 13, 661-8(1960) Nov.

The radiation response of Phycomyces in regard to growth rate and biochemical changes was analyzed. An interaction between visible light and ionizing rays occurs. Cultures grown under illumination differ from those grown in darkness in respect to some biochemical reactions (lactic acid concentration changes). Since the effect of ionizing radiation on the growth rate was found to be independent of whether light (dark) cultures were used, some reactions on the biochemical level do not seem to be directly connected with the influence on the growth-rate mechanism. The lactic acid changes were used as an indication of the general radiation sensitivity of all parts of the organism in regard at least to this biochemical property. Analyses of cultures grown on P^{32} did not support the notion that ionizing radiation causes permeability changes or diffusion effects within the organism. (auth)

2492 RADIOSENSITIVITY OF SEEDS. I. REDUCTION OR STIMULATION OF SEEDLING GROWTH AS A FUNCTION OF GAMMA-RAY DOSE. Thomas S. Osborne and James A. Bacon (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Radiation Research 13, 686-90(1960) Nov.

Dormant seeds of one or more varieties of 12 species, totaling 18 tests, were irradiated with Co^{60} γ rays over a wide range of doses. Treatments were randomized and replicated, with growth of first true leaf under greenhouse conditions as the criterion of radiation effect. About 40,000 seedlings were measured individually to the nearest millimeter. Statistical analysis delineated the doses between which seedling growth fell significantly below that of untreated controls. In the case of one wheat variety, there was apparent stimulation by the lowest three doses of radiation. Further tests are in progress. (auth)

2493 SERUM CHANGES IN SMALL PRIMATES EXPOSED TO ACUTE WHOLE-BODY Co^{60} RADIATION. William G. Glenn (School of Aviation Medicine, Brooks Air Force Base, Tex.). Radiation Research 13, 691-703(1960) Nov.

Statistically significant concentration changes in several serum components of 52 small primates (Macaca mulatta) exposed to 725 r of acute whole-body Co^{60} γ radiation were found. These changes were: increases in a glycoprotein(s) (mucoprotein), decreases in total serum protein, albumin, and gamma globulin, and inversion of the A/G ratio. Generally the results parallel an irradiation study done on a limited population of small primates infected with tuberculosis. Base-line information on total serum protein, albumin, and A/G ratios for a population of normal small primates is also given. (auth)

2494 EFFECTS OF LOW-FAT DIETS ON SURVIVAL TIME OF MICE EXPOSED TO MULTIPLE SUBLETHAL DOSES OF TOTAL-BODY X-IRRADIATION. Benjamin H. Ershoff (Western Biological Labs., Culver City, Calif.). Radiation Research 13, 704-11(1960) Nov.

The average survival time of mice exposed to multiple sublethal doses of total-body x irradiation was significantly less on a fat-free ration than on a similar diet supplemented with 10% cottonseed oil. Methyl linoleate when incorporated at a 1% level or desiccated liver at a 10% level in the fat-free ratio also increased survival of x-irradiated mice over that on the fat-free diet, but hydrogenated coconut oil at a 10% level of feeding was without protective effect. The active factor (or factors) in liver was present in

the liver-fat fraction obtained by azeotropic extraction with ethylene dichloride. (auth)

2495 NUCLEIC ACID METABOLISM IN HeLa S3 CELLS AFTER X-RAY-INDUCED MITOTIC DELAY. Robert B. Painter (Battelle Memorial Inst., Columbus, Ohio). Radiation Research 13, 726-36(1960) Nov.

The nucleic acid metabolism of HeLa S3 cells after x-radiation-induced mitotic delay was investigated. A depression in the percentage of cells in DNA synthesis accompanies resumption of mitosis, but is followed by a return to near-normal values in the evolving giant-cell population. As the number of cells in the population decreases, owing to abortive divisions, the percentage of cells in synthesis slowly decreases. One of the effects of irradiation appears to be a mixing of the cells in the S and G_2 phases of the population at the time of irradiation, so that cells from both compartments are in the population of cells that begin dividing after mitotic delay. The metabolism of RNA is little affected by doses of radiation up to 1500 r, and for times up to at least 14 days after the irradiation. After a short incubation with tritiated cytidine, the normal sequence of chromatin, nucleolar, and cytoplasmic labeling occurs in qualitatively the same manner in almost all irradiated cells, even the huge giants found 7 to 14 days after irradiation, as it does in unirradiated controls. (auth)

2496 HISTOLOGIC STUDIES OF NEUTRON- AND X-IRRADIATED MOUSE LENSES. T. C. Evans, R. D. Richards, and E. F. Riley (State Univ. of Iowa, Iowa City). Radiation Research 13, 737-50(1960) Nov.

Radiation cataracts seemed to develop in two stages. The first stage appeared to be the consequence of damage to individual cells of the lens epithelium. The resultant histological abnormalities were: (1) derangement of the lens bow pattern, (2) abnormal fiber elements in the cortex, (3) undifferentiated cells migrating under the capsule from the equator toward the posterior pole, and (4) an accumulation of abnormal cells and debris at the lens poles. At low doses, the progression stopped at this stage. With higher doses, cataracts progressed through this first stage to a second stage which involved all the structures inside the capsule. At this stage, when the lens was completely opaque, degenerative processes involved those fibers formed prior to irradiation and sometimes even the lens nucleus. Qualitatively, the types of damage produced by neutrons and by x rays were apparently no different. The rate of change was also the same when cataractogenically equivalent doses of neutron and x radiation were employed. Quantitatively, however, 1 rad of neutron radiation produced as much histologic abnormality as 4 to 6 rads of x radiation. Furthermore, when doses that were cataractogenically equivalent as a single dose were given as fractionated exposures, the effectiveness of the x radiation was very much reduced, whereas the effectiveness of the neutron radiation decreased very little, if any. (auth)

2497 THE RESPONSE OF NEOPLASMS TO X-RADIATION IN VIVO AT INCREASED OXYGEN TENSION. Anna Goldfeder and Grace E. Clarke (New York Univ., New York). Radiation Research 13, 751-67(1960) Nov

The response of two types of tumor to x irradiation in vivo at increased oxygen tension was investigated. One of the tumors under study was an epithelial type, designated DBAH; the other, a spindle-cell type, designated DBAG. Both types of tumor were grown by serial transplants in isologous hosts of the inbred DBA/212 strain of mice. It was found that a dose of 5000 r applied locally to the spindle cell tumors produced more total regressions in those mice breathing 100% oxygen at 3 atm. than in those breathing air. Somewhat similar results were obtained with 6000 r applied locally to the epithelial type of tumor. The significance of the results obtained and the implications involved are discussed. (auth)

2498 THE PROTECTION OF MICE AGAINST RADIATION BY 2-MERCAPTOETHYLGUANIDINE AND ITS DISULFIDE. Emanuel E. Schwartz and Bernard Shapiro (Albert Einstein Medical Center, Philadelphia). Radiation Research 13, 768-75(1960) Nov.

The ability of 2-mercaptoethylguanidine (MEG) to protect irradiated mice was compared with that of its oxidized form, bis(2-guanidoethyl) disulfide. Intraperitoneal administration of 100 and 140 mg/kg of each form resulted in comparable $LD_{50(30)}$s. However, GED in doses of 200 mg/kg and above gave rise to signs of drug toxicity which apparently prevented a further increase in protection such as was obtained with equivalent doses of MEG. The therapeutic efficiency of GED, as compared with MEG, was not increased by using the oral route despite the increased tolerance to the disulfide. (auth)

2499 HISTOLOGICAL ASPECTS OF LESIONS INDUCED IN THE HEMATOPOIETIC ORGANS OF IRRADIATED F_1 HYBRIDS BY INJECTIONS OF GANGLIONAL CELLS FROM ONE OF THE PARENTAL STRAINS. G. Mathé and J.-L. Amiel (Hospital Saint-Louis, Paris). Rev. franç etudes clin. et biol. 5, No. 1, 20-30(1960) Jan. (In French)

2500 RELATIVE BIOLOGICAL EFFECTIVENESS ON COMPACT EHRLICH-ASCITES TUMORS OF 250-kv AND 31-Mev X RAYS AND ELECTRONS. Hans Rudolf Kammer (Universität, Bern). Strahlentherapie 113, 178-92(1960) Oct. (In German)

The influence of different radiation qualities (250-kv x rays, 31-Mev x rays and 30-Mev electron radiation) on the mitosis of compact Ehrlich-carcinoma of the mouse was examined. The doses were 200 r and 300 r. The observation time was extended to 48 hr after radiation termination. The mitosis values of the conventionally and 31-Mev x ray irradiated tumors show no statistically proved differences, even when the curve of the conventionally irradiated runs throughout somewhat deeper. Those irradiated with fast electrons, as opposed to the conventionally and 31-Mev x-ray irradiated, appear to exhibit a somewhat quicker recovery out of the mitosis depression. At the moment this finding is only for one curve-point of the doses of 200 r and 300 r statistically ascertained. The displacements of the mitosis phases elapse in an equal sense by the different types of radiation. The controllable depression of the ana- and telo-phases up to 48 hours after radiation makes it probable that the further rise of the mitosis, which in our material is conditioned mainly through an increase of metaphase, is due rather to a temporal disturbance and eventual partial blocking in the cell-division course than to a further reviving cell-division activity. The RBE of the different radiation qualities on the mitosis remains the same if the carcinoma is radiated solely as a compact tumor as if it is influenced as ascites tumor by a total radiation. The effect is realized therefore directly upon the tumor and not through the general action by total radiation. On the grounds of the observation that the conventional and ultrahard x rays in the mitosis effect of the compact Ehrlich-carcinoma scarcely differentiate themselves, while on the other hand the effect of the conventional x rays on the growth-inhibition of the same tumor is significantly stronger, the conclusion is that the radia-

tion action on the tumor remission is not evaluated in the first place as a mitosis effect but is to be considered essentially as an effect on the cell-nuclei in inactivity. (auth)

2501 RESEARCH ON BIOLOGICAL RADIATION PROTECTION. XXXV. REPORT ON THE HEMATOLOGICAL LATE EFFECTS AFTER REPEATED WHOLE-BODY IRRADIATION OF WHITE MICE PROTECTED BY SEROTONIN. Hisatoshi Miyata, Hans-Joachim Melching, and Helmuth Rösler (Universität, Freiburg i. B.). Strahlentherapie 113, 193-200(1960) Oct. (In German)

For protection, inbred white mice were injected 5 min prior to irradiation with 5-hydroxytryptamine. A relatively great number of the animals survived triple x irradiations of 690, 810, 955, and 1050 r. The blood of 72 mice was examined 7 and 9 months following the last irradiation. None of the examined animals developed leukemia. On the first examination a lymphocytosis and a leucocytosis were observed, which had regressed at the second examination with the exception of a slight increase of the granulocytes. The red blood count was only slightly decreased, whereas there was a significant decrease of the hemoglobin. Abnormal myeloic and lymphatic cells were observed in increased number. The importance of the age of mice in comparative hematologic experiments was pointed out. (auth)

2502 EFFECTS OF IN VIVO X IRRADIATION ON RESPIRATION CYCLE PHOSPHORYLATION AND THE EFFECTS OF VITAMINS K_1 AND E. Dagobert Nitz-Litzow and Gérard Bührer (Radiotherapeutische Klinik des Kantonsspitals, Zurich). Strahlentherapie 113, 201-6(1960). (In German)

After x-ray irradiation in vivo the oxidative phosphorylation of liver mitochondria of rats is reduced. Through a pretreatment with vitamin K_1 and E this effect is lessened. The importance of these results for radiation biochemistry is discussed. (auth)

2503 EFFECTS OF X RADIATION ON THE PHOSPHATE METABOLISM OF ISOLATED MUSCLE. Hans-Dietrich Bergeder and Otto Hockwin (Universität, Bonn). Strahlentherapie 113, 207-16(1960) Oct. (In German)

The increase of the oxygen metabolism following irradiation of 150 kr on isolated sartorius muscles is combined with a decrease of the total content of high-energy phosphates (ATP, KP, and others). This decrease does not seem due to a disturbance of the energy-supplying metabolism processes, but possibly due to an effect on the energy-consuming processes, as it is demonstrated by the behavior of the specific activities of the high-energy compounds. As possible causes of the increased energy consumption the disturbance of the membrane potential and of the potassium concentration gradient, which occur at the same dose range, are discussed. (auth)

2504 EFFECTS ON THE RADIATION REACTION OF THE INTESTINE OF A COMBINATION OF LIVING ACIDOPHILUS- BIFIDUS- COLI BACTERIA. Jürgen Haller and Heinz Kräubig (Universitäts-Frauenklinik, Göttingen, Ger.). Strahlentherapie 113, 272-80(1960) Oct. (In German)

A favorable influence was achieved within a short time by the oral use of a new type bacteria combination (living acidophilus, bifidus, and coli bacteria, known as Omniflora upon radiation reaction of the intestines. The treatment must be continued for some time even after clinical improvement. On account of the detrimental effects of intestinal disturbances on the general power of resistance of the organism it appears advisable to apply, on principle, the bacterial implantations within the framework of the supplementary therapy. (auth)

2505 RADIATION PROTECTIVE EFFECTS OF YEAST CONCENTRATE. Hans Werner Pabst and Christian Strohm (Universität, Munich). Strahlentherapie 113, 286-98(1960) Oct. (In German)

The protective effect of concentrated yeast was studied on coli bacteria, barley seeds, and mice. The survival rate of coli bacteria following x irradiation could be increased by the administration of standardized concentrated yeast. It was also possible with barley seeds to obtain a radiation protection by concentrated yeast. The inhibition of the growth caused by x rays could be partially reversed by the administration of beer yeast. With animals the survival rate following whole-body irradiation with a lethal x-ray dose could be increased 20 to 25% by the oral or intraperitoneal treatment with yeast preparations. Studies on 120 patients showed a favorable effect of oral administration of concentrated yeast on the red blood count of x-irradiated patients and patients treated with radioisotopes. The radiation protection effect of concentrated yeast was compared with the effect of known substances for radiation protection and the mechanism of action was discussed. (auth)

2506 DONOR-TYPE LYMPHATIC TISSUE CELLS IN LETHALLY IRRADIATED MICE TREATED WITH HOMOLOGOUS FETAL LIVER. Otto Vos, Joan Wright Goodman, and C. C. Congdon (Oak Ridge National Lab., Tenn.). Transplantation Bull. 7, 408-11(1960) Apr.

Normal lymph node structure was found in lethally irradiated LAF_1 mice treated with homologous $101C3F_1$ fetal liver cells. Specific cytotoxic antisera prepared against host-type cells failed to react with bone marrow and lymph node cells. The conclusion is drawn that these cells are of donor origin. (auth)

2507 ATTEMPTS TO INDUCE TOLERANCE TO MATERNAL TISSUE BY IRRADIATION OF FETAL MICE. Miriam A. Moulton, J. Stimpfling, and J. B. Storer (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Transplantation Bull. 26, 454-5(1960) Oct.

Lengerova's work, which reported radioinduced tolerance in rats to maternal tissue by irradiation of embryonic rats with low doses of x rays, was repeated using mice with tissue incompatibilities between the mother and offspring and controlled by the H-2 locus. The pregnant mice were exposed to 200 r of x rays at 15 ± 1 days of gestation, and skin grafts from the maternal strain and other strains were applied to normal and irradiated hybrids at ages of 43 to 67 days, the grafts being examined daily for 30 days for evidence of a homograft reaction. There was no difference between the normal and irradiated mice in their rejection of unrelated strain grafts, and for maternal strain grafts the irradiated mice were found to reject their grafts a little earlier and to have a more severe reaction to the graft than the normal mice. Some of the differences between these experiments and those of Lengerova are discussed, along with possible explanations of the disagreement. (D.L.C.)

2508 THE STATE OF HEALTH OF PEOPLE SUBJECTED TO THE ACTION OF IONIZING RADIATION UNDER INDUSTRIAL-LABORATORY CONDITIONS. A. L. Morozov, E. A. Drogichina, M. A. Kazakevich, N. I. Ivanov, and S. F. Belova. Trudy Vsesoyuz. Konf. Med. Radiol., 20-5(1957). (In Russian)

A group of 60 people exposed to γ radiation in the course of radiographic work, and a group of 170 people working

with various radiation sources were subjected to clinical tests. An additional group of 40 people who showed symptoms of radiation sickness were subjected to more careful examination. The great majority of the subjects worked with radioactivity from 1 to 5 years, but about 20% were in contact with ionizing radiation for less than one year. Functional disturbances of the nervous system characterized by headaches, insomnia, increased tendency to fatigue, and weakness occurred three times more frequently with people who worked from 2 to 5 years with radiation as compared with people who worked with radiation less than one year. A decrease in sensitivity to vibration was noted in people with signs of radiation sickness. An increased threshold of olfactory sensitivity to thymol (in 77% of the patients) and rosemary was observed in a group of 107 people. This insensitivity to smell was particularly pronounced in the second group of people who were in direct contact with radioactive materials. The arterial blood pressure was low (100 mm or lower) in 40% of the subjects, an indication of an increase in vascular permeability. There was a tendency for the total albumins to increase, but the increase of globulin was especially marked in that the normal ratio of albumin to globulin of 1.3 to 1.82 was lowered to 0.94 to 1.2. The leukocyte and thrombocyte count was quite variable. A tendency to a slight lymphocytosis occurred more often. A neutrophilic shift to the left was frequently observed. In a significant number of cases there was a tendency to a moderate decrease in thrombocyte production. The most characteristic change in the blood was a heightened reticulocytosis observable in 40% of the subjects. There was a clear tendency to a prolonged bleeding time in almost one-half the patients, while other symptoms of hemorrhage such as a lower thrombocyte count were absent. The frequency of occurrence of cataracts in a group of 130 people could be correlated with the time of exposure to radiation. The relative frequency of cataracts was 7% for those under 40 years of age and 14% for those above 40 years of age for less than 5 years service. It was 25% for those under 40 years of age and 50% for those above 40 years of age for 6 to 10 years of service. It was 66% for those above 40 years of age with greater than 10 years of service. The possibility of some unknown process initiated by ionizing radiation that results in dystrophy changes in the eye cannot be excluded at this time. (TTT)

2509 THE DETERMINATION OF HYALURONIDASE, HISTAMINE AND ALBUMIN FRACTIONS IN PEOPLE SUBJECTED TO CONTINUOUS RADIATION EXPOSURE. E. P. Stepanyan, V. S. Klimova, and N. I. Gorbarenko. Trudy Vsesoyuz. Konf. Med. Radiol., 40-5(1957). (In Russian)

Hyaluronidase which promotes the breakdown of hyaluronic acid in protective polysaccharide barriers may be associated with the increased permeability of tissue during radiation sickness. The average hyaluronidase content in the blood serum of healthy people was 0 to 2 units as determined by the prolongation of the coagulation time of mucin or by a decrease in viscosity of the albumin addition compound with hyaluronic acid. A group of 123 people subjected to ionizing radiation were divided into three sub-groups (less than 1 year, 1 to 3 years, and more than 3 years length of service). The greatest number of people (about 40%) showed an increased hyaluronidase content (3.3 to 10 units) at 1 to 3 years service. Working with chemically toxic materials results in a 40% incidence of heightened hyaluronidase content (3.3 to 10 units). An increased histamine content varying from 11 to 25 γ % was found in the blood plasma of people subjected to ionizing radiation. The albumin fraction from blood plasma showed a decrease in albumin (41.5 to 54.6% compared to a normal value of 58%), an increase in γ-globulin (18 to 25.6% compared to a normal value of 17.2%), and an increase in β-globulin (14 to 19.8% compared to a normal value of 13.1%). People with 1 to 3 years of service also showed an increase in α_2-globulin (9.9 to 14.8% compared to a normal value of 7.6%). The changes in globulin content were accompanied by changes in hyaluronidase content which increase the permeability of tissues. (TTT)

2510 CREATINURIA IN PREGNANT AND NON-PREGNANT RATS AFTER EXPOSURE TO PENETRATING RADIATION. Z. N. Zhakhova and A. D. Braun. Trudy Vsesoyuz. Konf. Med. Radiol., 47-51(1957). (In Russian)

Disturbance of the creatine-creatinine balance in radiation sickness is an indication of general dystrophy. The normal excretion of creatine in the urine of healthy rats is 0.7 mg per day and that of creatinine is 4.6 mg per day. A fivefold increase in the amount of creatine excreted was observed on the second day after administration of a dose of 500 r with a return to normal levels on the 5th to 6th day after irradiation. The severity of the creatinuria is significantly higher for pregnant rats irradiated just before childbirth than it is for pregnant rats irradiated on the 11th to 12th day of pregnancy or for nonpregnant irradiated rats. The clinical symptoms of radiation sickness in the group of rats irradiated on the 11th to 12th day of pregnancy were much less pronounced, but the fetus died and was readsorbed. Irradiation of rats on the 19th day of pregnancy results in a prolongation of the gestation period to 24 to 25 days instead of a normal period of 21 to 22 days. The determination of the content of creatine and of creatinine can serve as a diagnostic aid in radiation sickness. (TTT)

2511 SPECIAL FEATURES OF THE REGENERATION OF BONE TISSUE UNDER CONDITIONS OF PENETRATING RADIATION. V. I. Stetsula. Trudy Vsesoyuz. Konf. Med. Radiol., 129-36(1957). (In Russian)

Immediately after irradiation with an x-ray dose of 650 r the right tibia was subjected to fracture in a group of dogs. The animals were sacrificed at various intervals (3 to 21 days) after irradiation, and sections of the tibia were prepared for staining reactions to observe the healing process during radiation. Observations were made on control animals also. A delay in the proliferation of the cellular elements of skeletal tissue was observed in the irradiated animals compared with the controls. The differentiation of the skeletal tissue was delayed. On the 7th day a rapid rebuilding of the bone took place, but because of resorption there was only a small amount of bone callus formed. The use of small doses of ionizing radiation (1.0 to 2.5 r per day) in all cases resulted in an increase in the rate of bone regeneration. (TTT)

2512 EXPERIMENTS ON THE TRANSPLANTATION OF OVA FROM THE OVIDUCTS OF UNIRRADIATED RABBITS INTO THE OVIDUCTS OF RABBITS SUBJECTED TO A SINGLE TOTAL DOSE OF X-RAYS. Z. F. Isachenko. Trudy Vsesoyuz. Konf. Med. Radiol., 149-53(1957). (In Russian)

Two female rabbits were mated and then one of the rabbits was irradiated with a dose of 250 r two days later. Ova were then interchanged between the two rabbits by transplantation. Observations on the per cent implantations of the number of transplanted ova were performed on the 9th to 10th day of pregnancy by surgical dissection. The rabbits were sacrificed on the 17th to 21st day of pregnancy, and the embryos and placentation were examined. Only 46% of the ova were viable in the control set after

transplantation; 27.4% of the irradiated ova in the unirradiated rabbits were viable; 30.8% of the unirradiated ova in the irradiated rabbits were viable, and 26.8% of the irradiated ova in the irradiated rabbits developed into embryos. Thus it is concluded that both direct irradiation of the ova and the maternal organism itself, when subjected to radiation, have a harmful effect on embryonic development. (TTT)

2513 EFFECT OF IONIZING RADIATION ON THE REACTIVITY OF THE ANIMAL ORGANISM. V. A. Samtsov, D. N. Lazareva, and R. G. Teregulov. Trudy Vsesoyuz. Konf. Med. Radiol., 174-7(1957). (In Russian)

Injection of 0.3 ml of an old slightly active filtrate of intestinal rod-shaped bacteria caused a 63.7% increase in leukocytes 24 to 72 hr later in a control group of rabbits. After irradiation (1200 to 1500 r) the same injection caused an average decrease in leukocytes of 35% on the 2nd to 4th day after irradiation. Similarly a subcutaneous injection of 0.1 ml of a culture of staphylococcus aureus resulted in a rapid development of a significant leukocytosis in unirradiated rabbits, but caused only a local festering with no effect on the leukocyte count in irradiated rabbits (1200 r) 24 hr after irradiation. Similarly, radiation caused a change in the animal organism to mobilize leukocytes in response to allergens (Arthus' phenomenon and Schwartzman's phenomenon). On the 6th to 7th day after irradiation the response to the allergen was feeble, but it was normal again 1½ months after irradiation. The action of adrenaline and carbocholine on blood pressure was investigated. On the 10th day after irradiation the blood pressure was 87 mm for the irradiated rabbits and 113 mm for the controls. Injection of adrenaline (0.5 ml per kg of body weight of a 1 : 30,000 solution) caused a rise in blood pressure of 73 mm (94%) in the irradiated rabbits and 62 mm (56%) in the unirradiated rabbits. The injection of carbocholine, especially on the 3rd to 6th day after irradiation, caused a sharp long-lasting drop in blood pressure (by 25 to 30%) in comparison with the control group. It was found that cholinesterase activity is more or less at a minimum on the 5th to 6th day after irradiation, but often rises again after this period. (TTT)

2514 EFFECTS OF HIGH-ALTITUDE COSMIC RADIATION ON BARLEY SEEDS. Jakob Eugster (Universität, Zurich) and David G. Simons. p.182-92 of "Physics and Medicine of the Atmosphere and Space." Otis O. Benson, Jr. and Hubertus Strughold, eds. New York, John Wiley & Sons, Inc., 1960.

The effects of high-altitude cosmic radiation on Hordeum barley seeds were investigated with balloon flights at 80,000 to 96,000 ft for 14 to 65 hr. The seeds were housed in plastic perforated holders covered on the top and bottom with Ilford G-5 plates to detect partial and central hits. After exposure, the seeds were compared with ground controls with respect to their growth, germination time, plant characteristics, etc., and these observations were repeated on successive generations. Out of 280 exposed seeds, 25 received central hits, 18 received partial hits, and 16 failed to germinate. Flight controls (exposed but not hit) showed some differences from ground controls. The results for seeds suffering hits are presented in terms of deviations of their characteristics from those of the ground controls; color mutations were observed in three seeds suffering central hits by heavy primaries. A thorough discussion of the results is given. (D.L.C.)

2515 RADIOBIOLOGICAL STUDIES WITH ACCELERATED HEAVY IONS. Cornelius A. Tobias (Univ. of California, Berkeley) and Tor Brustad. p.193-208 of "Physics and Medicine of the Atmosphere and Space." Otis O. Benson, Jr. and Hubertus Strughold, eds. New York, John Wiley & Sons, Inc., 1960.

A summary of radiobiological research performed with the HILAC accelerator and the Berkeley 184-in. synchrocyclotron is presented. Data were gathered on heavy ion effects on cells, viruses, enzymes, protein molecules, and animals, especially their central nervous systems. Some results are presented on the latter subject. A note is given on shielding for electrons and protons of the earth's radiation belt. (D.L.C.)

2516 BIOLOGICAL ASPECTS OF NUCLEAR PROPULSION. John E. Pickering (School of Aviation Medicine, Brooks AFB, Tex.). p.435-46 of "Physics and Medicine of the Atmosphere and Space." Otis O. Benson, Jr. and Hubertus Strughold, eds. New York, John Wiley & Sons, Inc., 1960.

A brief review is given of known biological effects of nuclear radiation, e.g., data on the peoples of Hiroshima and Nagasaki, accidental exposures to reactor radiation, and laboratory experiments on monkeys. The immediate effects of near-lethal doses and long-term effects of smaller doses received over long periods of time are discussed. Life-span shortening and leukemia deaths of radiologists and physicians are treated. It appears that human beings differ in their individual susceptibilities by a factor of 2. It is concluded that the risk of shortening life and increased susceptibility to leukemia are less than the risk in the overall reliability of the satellite-orbit system. (D.L.C.)

Radiation Sickness

2517 (JPRS-2706(8-15)) CHANGES IN CERTAIN ELECTROCARDIOGRAPHIC INDICES IN ACUTE RADIATION SICKNESS PRODUCED BY BETA-RADIATION AND X-IRRADIATION (AN EXPERIMENTAL INVESTIGATION). I. N. Bukhalovskii (Bukhalovskiy). Translated from Med. Radiol. 4, No. 9, 24-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 1370.

2518 (JPRS-2706(p.43-4)) THE EFFECT OF ASCORBIC ACID ON THE CARBOHYDRATE FUNCTION OF THE LIVER AND THE SURVIVAL RATE OF ANIMALS WITH ACUTE RADIATION SICKNESS. V. S. Yusipov. Translated from Med. Radiol. 4, No. 9, 78(1959).

Results are reported from a study of the influence of ascorbic acid on carbohydrate metabolism in the liver of irradiated rabbits and rats. (C.H.)

2519 (JPRS-2706(p.45-53)) THE ROLE OF ASCORBIC ACID IN RADIATION SICKNESS. V. S. Yusipov. Translated from Med. Radiol. 4, No. 9, 79-81(1959).

Evidence is presented for the participation of ascorbic acid in the complex mechanism of development of acute radiation sickness. (C.H.)

2520 (JPRS-2706(p.54-66)) SIX CASES OF ACUTE RADIATION SICKNESS IN PATIENTS DURING A NUCLEAR REACTOR ACCIDENT IN YUGOSLAVIA. H. Jamet, G. Mathe, B. Pendic, J. F. Duplan, B. Maupin, R. Latarjet, D. Kalic, L. Schwarzenberg, Z. Djukic, and J. Vigne. Translated from Med. Radiol. 4, No. 9, 83-90(1959).

The nature of the injuries in six persons exposed to mixed neutrons and gamma radiation during a nuclear reactor accident in Yugoslavia are described. The accident occurred on October 15, 1958 at the Yugoslavian Institute of Nuclear Energy near Belgrade. Values of induced radioactivity in the bodies of the patients are tabulated.

The values were determined by means of gamma spectrometric measurements of Na^{24}. Calculated neutron and gamma doses are reported. The clinical picture of each patient is described. Treatment consisted of symptomatic therapy and the administration of bone marrow emulsions to four of the patients. The patient who received the most radiation died on the 32nd day. A gradual improvement was noted in the other patients during the seventh week. A secondary immunological reaction in those given bone marrow injections is considered a possibility. (C.H.)

2521 (JPRS-2712) ALTERATION OF THE PERIPHERAL SECTION OF THE SKIN ANALYZER IN ACUTE RADIATION SICKNESS. N. N. Garvey. Translated from Zhur. Nevropatol. i Psikhiatrii 60, 135-9(1960). 7p. OTS.

Examination of the skin taken from various areas of the body of albino rats in the early period of acute radiation sickness revealed changes in the nerve endings in the epidermis and hair follicles within 30 min after radiation exposure. During the first 3 days following exposure, signs of irritation and dystrophy spread to involve the nerve fibers of both the superficial and deep layers of the derma and subcutaneous tissues. Morphological observations are illustrated. (C.H.)

2522 (JPRS-2799) TISSUE RESPIRATION AND GLYCOLYSIS IN THE DEVELOPMENT OF ACUTE RADIATION SICKNESS. D. A. Golubentsev and G. V. Sazykin. Translated from Voprosy Med. Khim. 6, No. 1, 49-52(1960). 8p. OTS.

Results are reported from a systematic study of the intensity of tissue respiration and glycolysis during the development of acute radiation sickness in rabbits. (C.H.)

2523 (JPRS-2928) DYNAMICS OF THE LEUKOCYTIC REACTIONS IN RABBITS IN ACUTE RADIATION SICKNESS. E. (Ye.) A. Dikovenko. Translated from Patol. Fiziol. i Eksptl'. Terap. 4, No. 1, 20-4(1960). 11p. OTS.

Radiation sickness which occurs in rabbits following a total-body irradiation with x rays in a dose of 600 r is associated with a change in the regulation of the blood system which is of a wave-form character. The leukocytic reaction to the parenteral injection of milk is inverted on the first day after irradiation, recovered on the third to tenth day, becomes paradoxical or is absent from the tenth to the twentieth day and is again recovered, exceeding the normal by the twenty-first to the thirtieth day. A disturbance in the regulation of the blood system does not coincide in time with the disturbance in the hematopoietic function. During the period of marked depression of hematopoiesis a parenterally injected protein stimulus produces a temporary increase in the leukocyte count. The paradoxical reaction is most pronounced during the period of incipient regeneration of the hematopoietic tissue. (auth)

2524 (JPRS-2931) THE PROBLEM OF THE MECHANISM OF ACTION OF PYRIDOXINE (VITAMIN B_6) IN ACUTE RADIATION INJURY. Z. I. Kalmykova. Translated from Patol. Fiziol. i Ekspti. Terap. 4, No. 1, 32-8 (1960). 15p. OTS.

The use of pyridoxine before irradiation in various species of animals exerts a pronounced protective effect. The administration of pyridoxine during the acute period of radiation injury causes a deterioration in the course and outcome of the sickness. The administration of pyridoxine before irradiation and the administration of small doses of histamine increase the histaminase content in the blood plasma, and the administration of these preparations in the acute period of radiation sickness reduces the activity of the enzyme. The use of the antihistamine preparation dimedrol during the acute period of radiation sickness simultaneously with pyridoxine eliminates the harmful effect of the pyridoxine on the course and outcome of the sickness and prevents a reduction in the blood histaminase level. The protective effect of pyridoxine when used prophylactically and the harmful effect when the vitamin is administered during the acute period of radiation sickness are to a large degree associated with the histamine-forming function of pyridoxine and with the content of histaminase in the body which destroys histamine. (auth)

2525 (JPRS-5018) TRANSPLANTATION OF BONE MARROW IN RADIATION INJURIES (LITERATURE SURVEY). Yu. M. Zaretskaya, M. P. Andreeva (Andreyeva), L. N. Kvasnikova, and S. A. Simkina. Translated from Vestnik Akad. Med. Nauk S.S.S.R. 15, No. 2, 63-72(1960). 18p. OTS.

Results are reviewed from a number of studies on the transplantation of bone marrow in irradiated animals. The case histories are reviewed of six Yugoslav physicists who received doses of mixed neutrons and γ radiation ranging from approximately 400 to 1200 rem. The response of the patients to bone-marrow transfusions is described. Suggestions based on data from these patients and on the experience of the authors in the treatment of leukemia in children with bone-marrow transplants are offered for the preparation of both donor and recipient. The case history is included of a 16-year-old patient who was considered clinically cured on the 203rd day following irradiation and bone-marrow transplantation. Methods for obtaining and preserving bone marrow are also described. (C.H.)

2526 (JPRS-5551) INTRATRACHEAL ETHER ANESTHESIA IN OPERATIONS ON THE LUNGS IN THE PERIOD OF RADIATION SICKNESS (EXPERIMENTAL INVESTIGATION). (Intratrakheal'nyy Efirnyy Narkoz pri Operatsiyakh na Legkikh v Period Luchevoy Bolezni (Eksperimental'noye Issledovaniye)). A. D. Yarushevich. Translated from Vestnik Khirurg. im. Grekova 84, No. 5, 87-92(1960). 11p. OTS.

Intratracheal ether anesthesia in an experiment on dogs, used in the presence of traumatic operations on the lungs in the latent, initial, and pronounced periods of radiation sickness, did not raise the mortality of the irradiated animals. The elimination of motor excitation during the entrance into narcosis improves the outcome of the operative intervention. Morphine, atropine, and aminazine can be used for anesthesia premedication without a negative influence on the course of the radiation sickness. Introductory narcosis by the intravenous administration of thiopental-sodium or of pentothal also is not reflected unfavorably in the postoperative course of the irradiated animals. The use of ditilin for muscle relaxation in these animals requires care since they apparently possess a raised sensitivity to it. No hypotensive effect of hexonium and pentamine was obtained on animals with radiation sickness. (auth)

2527 (JPRS-5774) CONFERENCES ON THE PROBLEM OF ACUTE RADIATION SICKNESS. (Konferentsii a po Probleme Ostroy Luchevoy Bolezni). L. G. Ratgauz. Translated from Vestnik Akad. Med. Nauk S.S.S.R. No. 2, 89-94(1960). 12p. OTS.

A summary is presented of findings reported at a conference on acute radiation sickness and its remote complications held Oct. 19–21, 1959, at the Institute of Experimental Pathology and Therapy of the Academy of Medical Science USSR in Sukhumi. The basic problems treated were: particularities of the course of acute radiation sickness in monkeys, radiosensitivity effects of various substances in mammals, infectious complications, and remote complications. (T.R.H.)

2528 (UCRL-Trans.-567) THE INFLUENCE OF INSULIN ON THE COURSE AND OUTCOME OF RADIATION SICKNESS. V. N. Patalova. Translated by Esther Goldberg from Farmakol. i Toksikol. 22, 555-7(1959). 8p. JCL or LC.

An experiment was carried out with 1450 white male mice injected with insulin in distilled water with doses of 0.05, 0.1, 0.2, 0.3, and 0.5 unit/kg at 15 and 30 min, and 1, 2, and 3 hr before exposure to 600 or 800 r. It was found that 0.1 to 0.2 unit/kg 1 to 2 hr before irradiation gives moderate protection as shown by higher leukocyte count, weight, and earlier recovery. Repeated injections of 1 unit/kg after exposure show some promise. (T.R.H.)

2529 CHANGES OF NEUROHUMORAL SUBSTANCES OF THE BLOOD DURING THE DEVELOPMENT OF EXPERIMENTAL CHRONIC RADIATION SICKNESS. N. E. Kuznetsova (Inst. of Neurology, Academy of Medical Sciences, USSR). Med. Radiol. 5, No. 9, 3-10(1960) Sept. (In Russian)

The results are presented for studies on the dynamics of acetylcholine and the activity of cholinesterase, histamine, adrenaline of the blood of dogs during the development of chronic radiation sickness, induced by repeated and numerous action of fractional doses of ionizing radiation. The irradiation was instituted daily at a dose of 15 r with two RUM-3 apparatus, with a capacity of 7 to 8 r/min. The substances were investigated before and after the irradiation, once or twice weekly throughout the course of chronic radiation sickness (4 to 6 months). The most acute changes are found in the initial stage of chronic radiation sickness. They are characterized by: a rise of acetylcholine content; a drop of cholinesterase activity; an elevation of the histamine content; an increase of the content of adrenaline-like substances at the beginning with its subsequent diminution; and a rise of adrenaline. Then there are observed undulating changes in the content of neurohumoral substances of the blood which are manifested by insignificant variations near the initial level. Changes of the neurohumoral substances of the blood in a pronounced clinical picture are expressed by: a rise of acetylcholine; a drop of cholinesterase activity; an increase of histamine level; and inconsiderable fluctuations in the content of adrenaline-like substances. At the terminal stage the acetylcholine level in the blood remains elevated with a further reduction of cholinesterase activity. The histamine content remains increased or even rises higher; the values of adrenaline-like substances fluctuate within the limits of the initial level. (auth)

2530 CLINICAL PICTURE CHARACTERISTIC OF EXPERIMENTAL CHRONIC RADIATION SICKNESS. I. N. Molokov and A. G. Khanin (Inst. of Neurology, Academy of Medical Sciences, USSR). Med. Radiol. 5, No. 9, 10-13 (1960) Sept. (In Russian)

Daily exposure to relatively low doses of ionizing radiation, by cumulating gradually, produce chronic radiation sickness, the development of which is distinguished by four stages: that of primary manifestations; the stage of relative clinical well-being; the pronounced clinical manifestations; and the terminal stage. Each one of the above stages had its own features, which became manifest the sooner the less resistant proved to be the experimental dogs to the ionizing radiation. The description of the clinical picture included observations over the behavior of the dogs, their appetite, weight, stool, body temperature, pulse rate, blood measurements, and the condition of their fell and mucous membranes. (auth)

2531 CHANGES OF THE IMPULSATION IN THE VAGUS NERVE TRUNK OF RABBITS IN ACUTE RADIATION SICKNESS. G. V. Bavro. Med. Radiol. 5, No. 9. 13-18(1960) Sept. (In Russian)

The results are given for an investigation of the impulsation in the vagus nerve of rabbits subjected to total body x-ray irradiation at 1000 r. Phase changes of the nerve-action currents were observed. In experiments with ligation of the nerve and tapping of action currents from its central and peripheral ends, it is shown that an intensification of the impulsation, observed immediately following irradiation, occurs, mainly at the expense of intensification of afferent signals. (auth)

2532 ANALYSIS OF THE INFLUENCE OF SURGICAL PROCEDURE UPON THE STATE OF LEUKOPOIESIS IN IRRADIATED ANIMALS. N. I. Shmeleva (Central Scientific Research Inst. of Medical Radiology, [USSR]). Med. Radiol. 5, No. 9, 26-9(1960) Sept. (In Russian)

regeneration in irradiated rats subjected to a surgical procedure. On the basis of data obtained, an inference is drawn that the principal cause of an earlier blood picture restoration in rats with combined injuries is due to a short-term ether anesthesia which was instituted during the operation. The operation was performed on rats during the development of radiation sickness of moderate severity. (auth)

2533 THE FEATURES PECULIAR TO THE COURSE OF EXUDATIVE PLEURITIS IN ACUTE RADIATION SICKNESS (EXPERIMENTAL RESEARCH). M. S. Lipovetskiĭ, Ya. I. Veksler, A. R. Sheĭngerts, and L. I. Radyuk. Med. Radiol. 5, No. 9, 47-55(1960) Sept. (In Russian)

In experiments on 55 rabbits it is shown that exudative pleuritis, developing against the background of radiation sickness, acquires a number of characteristic features: an acute and rapid development of anemia; an impetuous course of pleuritis with a marked hemorrhagic nature; the formation in the pleural cavity of extensive blood clots, a considerable retardation of the process of exudate resolution; and frequent complications of pneumonia, a high lethality rate among the affected animals. The most severe course of the disease is observed in instances when experimental pleuritis is induced at the peak of acute radiation sickness. Exudative pleuritis aggravates and accelerates the development of radiation sickness: the latent period shortens; the onset of leukopenia occurs earlier and is more pronounced; and the normalization of hematological indices is impeded for a considerable time. The pathomorphological picture of pleuritis in combined radiation injuries is characterized by an inflammatory process of a prevalently hemorrhagic nature with areas of hemorrhage and necrosis, and with frequent involvement into the process of pulmonary parenchyma. (auth)

2534 THE EFFECT OF ADRENALIN ON THE RENAL FUNCTION OF DOGS DURING RADIATION SICKNESS INDUCED BY POLONIUM. Z. I. Poluboyarinova. Med. Radiol. 5, No. 9, 55-9(1960) Sept. (In Russian)

In a subacute form of radiation sickness produced by polonium the effect of adrenalin on the renal function is pronounced to a greater extent than in intact animals. The information derived from experiments testify to an elevated sensibility to the effect of adrenalin of both the filtration glomerules and reabsorption tubules. Determination of the changes in the index showing the ratio of urea-chlorewater in the dynamics attending the development of radiation sickness demonstrated the growing hypofunction of the suprarenals 30 days following the injury produced by polonium. (auth)

2535 BILIGENIC LIVER FUNCTION IN DOGS EXPOSED TO POLONIUM RADIATION. L. L. Fedorovskiĭ. Med. Radiol. 5, No. 9, 59-62(1960) Sept. (In Russian)

Experiments were staged on 5 dogs with chronic fistulae of the gall bladder under conditions of acute and subacute radiation sickness, induced by polonium. Phasic changes in the external secretional function of the liver were disclosed, viz; the increased section in the first days of the disease gave place to the normalization of the secretory process with its subsequent sharp inhibition. (auth)

2536 FRACTION COMPOSITION OF SERUM PROTEINS FOLLOWING ACUTE EXPOSURE TO IONIZING RADIATION UNDER CONDITIONS CREATED BY EXCITEMENT AND INHIBITION OF THE CENTRAL NERVOUS SYSTEM. Yu. S. Tatarinov and F. M. Tsukrova. Med. Radiol. 5, No. 9, 86-7(1960) Sept. (In Russian)

Changes in the composition of serum protein in radiation sickness were studied considering the initial functional condition of the central nervous system. Tests were made on 12 dogs weighing 5 to 12 kg. The dogs were divided into three groups: a control group, a group given phenanin during 2 to 3 weeks before and after exposure, and a group given daily injection of chlorohydrate for a week preceding and following exposure. In all cases the chlorohydrate induced 3- to 5-hr sleeps. Acute radiation injuries were inflected by irradiation of the stomach to 500 to 600 r at 10 r/min. The dogs perished on the fourth day following exposure, usually losing 10% of their original weight. The clinical picture in dogs irradiated during narcotic sleep showed less pronounced hemorrhagic action in the intestines. However, neither chlorohydrate nor phenanin prevented fatality, and all animals died at nearly identical times. Animals treated with phenanin or chlorohydrate had a comparatively low initial albumen content and relatively high contents of α_1 and γ globulin. In contrast to control animals, neither hyperalbumin nor an increase of α_2 globulin was observed in the treated animals during the course of the sickness. (R.V.J.)

2537 ORIGINAL ARTICLES AND SURVEYS. A. PROBLEMS OF HEMATOLOGY. HUMORAL MECHANISMS OF THE HEMOPOIETIC CHANGES IN ACUTE RADIATION SICKNESS. N. A. Fedorov, A. M. Namiatysheva, M. G. Kakhetelidze, N. S. Rozanova, and N. A. Zhizhina (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Problems Hematol. Blood Transfusion (U.S.S.R.) (English Translation) 5, 229-37(1960).

The morphological composition of the peripheral blood and bone marrow was studied in parabiotic rats after irradiation of one of the parabionts. No signs of injurious effects of radiation were observed in the hemopoietic organs of the nonirradiated partner. Findings are described and discussed. (C.H.)

2538 AN EFFECTIVE THERAPEUTIC REGIMEN FOR THE HEMOPOIETIC PHASE OF THE ACUTE RADIATION SYNDROME IN DOGS. D. K. Sorensen, V. P. Bond, E. P. Cronkite, and V. Perman (Brookhaven National Lab., Upton, N. Y.). Radiation Research 13, 669-85(1960) Nov.

A therapeutic regimen consisting in administration of large amounts of fresh whole blood when indicated to control bleeding, the judicious use of antibiotics to control infection, and parenteral fluids to combat dehydration was successful in reducing the mortality from nine of ten untreated controls to two of ten in the treated group. The dogs were exposed to 400 r of x irradiation measured free in air at the position corresponding to the proximal skin surface. It was found easier to control hemorrhage by fresh whole-blood transfusion than to control infection with antibiotics. Regeneration of the bone marrow as reflected by peripheral counts commenced on approximately the twenty-third to the thirtieth day postirradiation. The leukocytes appeared several days earlier than the platelets in all dogs. The rate of regeneration was different in the treated dogs and was slower in the four smaller dogs. The preirradiation-platelet, leukocyte, and red-blood-cell levels were not reached at the end of 100 days in these four dogs. The greater degree of effect seen in smaller dogs is discussed in terms of the greater tissue, or absorbed dose received by these animals with a given air-exposure dose. (auth)

2539 THE ACUTE RADIATION SYNDROME IN DOGS AFTER TOTAL-BODY EXPOSURE TO A SUPRALETHAL DOSE OF IONIZING RADIATION ($Co^{60}LD_{100/88\,hours}$). Stanley Wing Handford (Naval Medical Research Inst., Bethesda, Md.). Radiation Research 13, 712-25(1960) Nov.

Changes in the following variables were measured in two groups of dogs before and after exposure to a supralethal dose of γ-radiation $LD_{100/88}$ hr: (1) blood picture, (2) serum protein and electrolyte levels, (3) measured and estimated total blood volume and ratio F cells, (4) clearance of rose bengal as an estimate of hepatic blood flow, and (5) clearance of Diodrast as a measure of renal blood flow. In group 1 measurements were made at daily intervals until exitus, and the results from each dog were compared with its preirradiation baseline values and with those from a sham-treated group; in group 2, in order to minimize blood loss from sampling, only baseline and premortal determinations were made. In both groups, after proper allowance was made for sampling deficits, the results were similar. (1) The well-known changes in the leukocyte picture were again observed: early abortive leukocytosis was followed by rapidly progressive leukopenia until only a negligible number of white cells were present at 12 to 18 hr before death. (2) No significant changes in serum electrolyte or protein levels were observed that could be interpreted as contributing to the death of the animal. (3) Significant reductions in total blood volume brought about by a reduction in red cell mass and a relatively greater reduction in plasma volume occurred only in the premortal stage (10 hr or less before death) and only in a few instances were the reductions in blood volume of the magnitude to be considered intolerable. (4) Both hepatic and renal blood flow were well-maintained until shortly before death, when a general collapse of the circulation occurred. (auth)

2540 CLINICAL ASPECTS OF CHRONIC RADIATION SICKNESS. A. V. Kozlova, V. M. Malenkova, E. V. Karibskaya, and T. S. Seletskaya. Trudy Vsesoyuz. Konf. Med. Radiol., 14-20(1957). (In Russian)

Clinical tests were performed on 156 people systematically exposed to ionizing radiation in the course of their work. The first symptoms to appear involved a disturbance of the central nervous system as evidenced by a change in magnitude of various reflexes. One of the earliest indications of radiation sickness was shown by a lowering of the oxygen capacity of the hemoglobin of whole blood (1.11 to 1.31 ml) in 60% of the people under investigation; a normal oxygen capacity was shown in 11% of the people and a high capacity (1.36 to 1.38 ml) in 29% of the people. The hemoglobin content hardly varied. It was within normal limits (12.5 to 15 g %) for 48% of the people and somewhat higher (15 to 17 g %) for 52% of the people. Blood cell changes were also observed. The changes in red cell count were small. A light anemia (number of erythrocytes <4,000,000 per mm^3 of blood) was observed in 10 patients and a slight

erythrocytosis (number of erythrocytes >5,000,000 per mm^3 of blood) was observed in 14 other patients. Changes in the white blood count were more pronounced. The leukocyte count was <4000 in 11 patients, 4000 to 5000 in 87 patients, and 5000 to 6000 in 58 patients. Lymphopenia was found in 97 patients. A shift to the left was observed in 79 patients. A thrombocyte count of <200,000 was observed in 27 people and a count of 200,000 to 300,000 was observed in 85 people. A prolonged coagulation time was observed in 22 people and a delayed coagulation time in 38 people. A prolonged bleeding time of greater than 2 min was noted in 41 people with 7 people having a bleeding time of about 17 min. The most frequently observed pathological condition was the occurrence of leukopenia and lymphopenia with a shift to the left and a tendency to thrombocytopenia. Some pathological symptoms could be observed in over 90% of the people, and the frequency of occurrence of the pathological symptoms increased almost linearly with the time of exposure to ionizing radiation in years. (TTT)

2541 CLINICAL ASPECTS OF SEVERE SICKNESS CAUSED BY EXTERNAL BETA RADIATION. Yu. V. Sebrant. Trudy Vsesoyuz. Konf. Med. Radiol., 26-30 (1957). (In Russian)

Mature dogs and 2 to 3 month old pigs were irradiated with P^{32} and fission product β emitters over an area of 80 cm^2 locally ($^1/_{20}$ to $^1/_{25}$ of the total surface area of the animal) and in a special chamber for the whole-body radiations. A labile hyperemia was observed at 1.3 to 1.5×10^4 ergs/cm^2, but at 4×10^4 ergs/cm^2 the hyperemia was more persistent. At 6×10^5 ergs/cm^2 the latent period was shortened. Erythema with edema occurred, and the animal perished in 3 to 5 months. The parts of the body most sensitive to whole-body β irradiation were the large joints, the groin, armpits, scrotum, region near the sex organs, mouth, shoulder-blades, and spine. Formation of blisters was observed in the whole-body experiments. At 3.5×10^4 ergs/cm^2 a scarcely noticeable hyperemia occurred, but on increasing the dose by a factor of 4.5 to 1.5×10^5 ergs/cm^2, the dose was a deadly one for a given type of animal. A clinical comparison of the pathological symptoms caused by γ radiation and by external β radiation showed that these two forms of radiation sickness have nothing in common. Experiments in which β and γ irradiation were administered simultaneously showed that the β radiation rapidly brought about the death of the animal due to radiation sickness, even at β doses which in themselves could cause no serious damage. (TTT)

2542 FUNCTIONAL CHANGES OF INTERNAL ORGANS AND SYSTEMS DURING SEVERE RADIATION SICKNESS FROM EXTERNAL RADIATION. G. A. Zedgenidze. Trudy Vsesoyuz. Konf. Med. Radiol., 30-6(1957). (In Russian)

Animals display different degrees of sensitivity to the action of ionizing radiation. At first increased intestinal motility of the alimentary tract is observed followed by a significant decrease in intestinal motility with radiation sickness of the third degree. Irradiation of the thoracic cage results in zonal atelectasis followed by emphysema. Severe pneumonia resulting in death may develop. Contraction of the small bronchioles and expansion of the larger bronchioles is observed during radiation sickness. A decrease in muscle tone of the alimentary tract is accompanied by a decrease in muscle tone of the bronchial tubes. During moderate or severe radiation sickness it was noted that the flow of bile through the gall bladder was slowed down considerably. This disturbance in function of the liver and gall bladder could be frequently observed even during the latent period of radiation sickness. Damage to the kidneys during severe radiation sickness was noted by the fact that the sergosine clearance test took 300 min instead of the usual 40 to 80 min. A slowdown in kidney elimination was observed in all phases of radiation sickness, and hence, a determination of kidney function by urography is of value as a clinical test in the detection of mild radiation sickness. The subcutaneous injection of vitamins C, B_1, and B_2 moderated the course of the radiation sickness. It is concluded that the functional disturbances in internal organs such as the liver, kidneys, gall bladder, stomach, etc., are much more severe than the anatomical changes observed by histological examination. (TTT)

2543 CHOLINE CONTENT IN THE BLOOD OF PEOPLE WITH RADIATION SICKNESS. M. P. Eleazarova and V. S. Stepanova. Trudy Vsesoyuz. Konf. Med. Radiol., 45-7(1957). (In Russian)

One of the early effects of radiation sickness is a decrease in choline content of tissue and of the blood. The choline content of the blood was low (0.1 to 1.9 mg % compared to a normal value of 3.0 to 3.8 mg %) in 47 out of 50 people who were systematically exposed to radiation in the course of their work and had contracted radiation sickness of the first degree. Sixteen of 20 people with third degree cancer were found to have a low choline content (0.14 to 1.68 mg %) even before radiation treatment with Co^{60}. After radiation treatment with doses of 100 to 200 r an increase in choline content (0.24 to 3.2 mg %) was observed in 80% of the cases 24 hr after treatment. During further radiation treatment the choline content of all patients decreased to the initial rather low values (0.4 to 0.7 mg %). Changes in the choline content of the blood can be of diagnostic value in the detection of early radiation sickness. (TTT)

2544 TREATMENT OF SEVERE AND CHRONIC FORMS OF RADIATION SICKNESS. A. A. Bagdasarov and L. S. Rogacheva. Trudy Vsesoyuz. Konf. Med. Radiol., 51-4(1957). (In Russian)

Treatment with 6 to 8 daily transfusions of blood substitutes (150 to 200 ml of albumin) was found to be more effective than the use of citrated blood in the treatment of dogs irradiated with a dose of 600 r (50% survival). Injection of a leukocyte concentrate containing more than a billion leukocytes on 10 to 11 occasions beginning with the onset of leukopenia on the 6th to 8th day after irradiation restored the leukocyte count and increased the survival rate to 80% (4 out of 5 dogs survived). Treatment of 110 people suffering from radiation sickness by repeated transfusions of a leukocyte concentrate (two billion leukocytes) each 3 to 4 days stimulated the production of leukocytes (from 1000 or less to 2000 to 4000 leukocytes per cm^3 in the majority of cases). An increase in granulocytes and thrombocytes was noted in most cases. The use of blood treated with a cation ion-exchanger and a leukocyte concentrate is a highly effective combination in the treatment of radiation sickness. (TTT)

2545 TRANSFUSION OF A LEUKOCYTE CONCENTRATE FOR LEUKOPENIA ORIGINATING FROM RADIATION SICKNESS. Z. G. Arlozorov, Sh. A. Burshteĭn, B. M. Varshavskiĭ, and G. I. Freĭman. Trudy Vsesoyuz. Konf. Med. Radiol., 59-62(1957). (In Russian)

A leukocyte concentrate prepared from preserved blood was successfully used to increase the white cell count in a majority of 47 patients suffering from leukopenia as a result of large doses of radiation received during cancer irradiation treatments. One to nine transfusions in intervals of 2 to 4 days with a transfer of one to five billion leuko-

cytes were required depending on the response of the individual. The treatment was ineffective in patients with bone cancers that impaired the hematopoietic function of the bone marrow. However, in a significant number of cases, a permanent increase in the number of leukocytes was obtained along with an improvement in the general state of health of the patient. The possibility of preparing the leukocyte concentrate from preserved blood makes the method available for general use. (TTT)

2546 EXPERIMENTAL DATA ON A CONVALESCENT-PREVENTIVE DIET DURING RADIATION SICKNESS. S. R. Perepelkin. Trudy Vsesoyuz. Konf. Med. Radiol., 62-7 (1957). (In Russian)

A diet containing proteins of milk (37%), eggs (14%), and meat (20%); a milk diet with proteins of milk (52%) and meat (20%); a liver diet with proteins of liver (50%) and meat (20%); a meat diet with 69% of the protein from meat; and a normal diet with 62% of the protein from meat and 8% from milk were used on rats irradiated at doses of 550 and 500 r. The improvement in survival rate was 30% for the meat diet, 42.5% for the liver diet, and 45% for the milk-egg diet at a dose of 500 r. By enriching the respective diets with vitamins PP, P, and C, the survivals were 23% for the meat diet, 46% for the liver diet, and 54% for the milk-egg diet (54 survivals out of a total of 100 rats irradiated). The number of survivals of dogs irradiated at 350 and 400 r was 9 (56.2%) for the normal diet, 5 (55.5%) for the liver diet, and 11 (68.7%) for the milk-egg diet. By enriching the diet with vitamins PP, P, and C (10 mg/kg) the survival rate was increased (7 out of 9 dogs on the milk-egg diet survived at a dose of 400 r). Two dogs were put on a milk-egg diet and a meat diet, respectively, for 10 days and then inoculated with 0.5 mc Sr^{90}/kg. The dog on the milk-egg diet eliminated 76.5% of the Sr^{90} in 24 days and survived, while the dog on the meat diet eliminated only 21% of the Sr^{90} and perished on the 23rd day. (TTT)

2547 PROTECTIVE EFFECT OF A COMBINATION OF ADRENALINE AND ACETYLCHOLINE DURING RADIATION SICKNESS OF ANIMALS. L. F. Semenov and E. A. Prokudina. Trudy Vsesoyuz. Konf. Med. Radiol., 68-71(1957). (In Russian)

A dose of 12.5 γ of adrenaline and 2 mg acetylcholine given to white mice just before irradiation with a dose of 700 r resulted in 35% survivals, while 100% of the controls died. A combination of adrenaline and cysteine or of acetylcholine and cysteine was also found to be effective (23 and 42% survivals, respectively). Acetylcholine iodide, dimercaptocholine iodide, and phenylcysteine, separately or in combination, as well as a combination of acetylcholine with SH-adrenaline or of S-acetylcholine with adrenaline, were ineffective. Replacement of adrenaline by compounds which were similar in structure and which were physiologically active such as phenamine, phenylethyl amine, and tyramine were very effective as protective agents with survivals of 36, 50, and 50%, respectively. Under the same conditions the survivals for such well-known protective agents as cysteine, cystine, and thiourea are 10, 15, and 23%, respectively. On replacing adrenaline by its analogs no side reactions are observed and there is reason to believe that the new combinations are less toxic than the combination of adrenaline and acetylcholine, and that they still retain the protective function of the latter combination. (TTT)

2548 PHARMACOLOGICAL CHARACTERISTICS OF BECAPTAN (β-MERCAPTOETHYLAMINE) AND ITS EFFECTS ON THE COURSE AND OUTCOME OF RADIATION SICKNESS. S. Ya. Arbuzov, I. I. Baryshnikov, V. I. Generalov, and E. A. Mukhin. Trudy Vsesoyuz. Konf. Med. Radiol., 71-7(1957). (In Russian)

Mice (weight 18 to 26 g) were irradiated with a dose of 700 r. It was found that previous administration of doses of phenatine (1 to 3 mg/kg), propyl-2-phenamine (1.00 mg/kg), and phenylphenamine (2 to 25 mg/kg) had a beneficial effect in increasing the time of survival and the number of survivals. Substances which paralyze the nervous system such as atropine (0.0124 mg per mouse) and spherophysin (0.3 to 0.6 mg per mouse) were ineffective. Of the sulfur-containing substances it was found that dinicotinylsulfide (3 mg per animal) and paraminobenzene disulfide (1 mg per mouse) had no effect on the outcome of radiation sickness. A study of the β-mercaptoethylamine derivative, diethyldisulfidemercaptoethylamine (dose of 2 mg per mouse), showed that these substances possessed no protective action and were more toxic than becaptan. It was found that the relative toxicity of the new salts of β-mercaptoethylamine, the ascorbate and the nicotinate, was 0.6 compared to 1.1 for salicylate salt and 1.0 for β-mercaptoethylamine itself. These new salts (dose of 3 mg per mouse) were as effective as becaptan in moderating the outcome of severe radiation sickness. Administration of 3 mg of becaptan with 0.0125 mg of atropine per mouse before irradiation was more effective than the use of becaptan by itself. A decrease in blood pressure was observed at doses of 5 to 30 mg/kg of becaptan. A decrease in the hypotension effect was noted after dosing with atropine. In large doses (70 to 100 mg/kg) the reflexes of the spinal cord were slowed down in rabbits, particularly under narcosis. Because of these side effects it is desirable to use becaptan in combination with atropine and other substances. (TTT)

2549 THE HEALING OF WOUNDS OF THE SOFT TISSUES AND OF BONE FRACTURES DURING RADIATION SICKNESS UNDER EXPERIMENTAL CONDITIONS. N. I. Blinov. Trudy Vsesoyuz. Konf. Med. Radiol., 81-6 (1957). (In Russian)

Observations on wounds made on the soft tissues of rabbits and guinea pigs irradiated at a dose of 800 r showed that the wounds healed slower (on the 23rd to 26th day compared to healing by the 14th to 18th day for the controls). The application of streptomycin each day for nine days promoted the healing of the wound, but had no effect on the recovery of the animal from the radiation sickness. The healing of bone fractures in irradiated rabbits required 10 to 14 days longer than that required for the control group. (TTT)

2550 EFFECT OF NARCOSIS AND OF AN ABDOMINAL OPERATION ON THE COURSE OF RADIATION SICKNESS. I. Ya. Tikhonin, I. S. Kas'yanov, and N. T. Vaganova. Trudy Vsesoyuz. Konf. Med. Radiol., 91-6 (1957). (In Russian)

Groups of rabbits and dogs were irradiated at 600 and 500 r, respectively, anesthetized with morphine-ether or by a nerve block with Novocain, and operated upon for stomach resection with an infusion of penicillin to prevent infection. One control group was anesthetized and operated upon, but was not irradiated. Another control group was irradiated and anesthetized, but was not operated upon. The use of a morphine-ether anesthetic during operation resulted in a cessation of respiration and enlargement of the right side of the heart (7 out of 11 animals died during the operation). No complications could be observed with the use of a Novocain block as an anesthetic. The most favorable period for operative intervention was the latent period (one to two days after irradiation). Operations per-

formed at the height of the radiation sickness (7 to 14 days after irradiation) were complicated by a failure of the incision to close, necrosis at the site of the incision, and an increased tendency to hemorrhage during the operation. Leukopenia, decreased hemoglobin, a decrease in the albumin to globulin ratio, and a decrease in the number of erythrocytes were observed in all animals during the postoperative period. (TTT)

2551 SURGICAL TREATMENT OF FIREARM WOUNDS OF AN ANIMAL ON A BACKGROUND OF PREVIOUS INJURY BY PENETRATING RADIATION. L. M. Kotel'nikov. Trudy Vsesoyuz. Konf. Med. Radiol., 96-101 (1957). (In Russian)

Dogs irradiated at a dose of 300 r from a Co^{60} source were shot with a small caliber pistol. The control dogs were not irradiated, but were shot and subsequently treated in the same way as the irradiated group. Operative intervention was carried out 4 to 10 hr after the shooting under aseptic conditions with the use of nitrous oxide and ether as anesthetics. Protein concentrates, glucose, blood transfusion, vitamins, and antibiotics were used freely, but over one-half of the irradiated and nonirradiated animals died in the first few days due to loss of blood and traumatic shock. The present methods of treating firearm wounds (especially the administration of a protein solution to moderate the effects of shock) were as effective for irradiated animals as for animals that were not radiated. Slow healing of the wound, lack of tonus of the intestine, and peritonitis were observed in the irradiated animals. Changes in the blood picture such as the occurrence of leukopenia, lymphopenia, neutrophilia, and a shift to the left were observed after the animal was well on the way to recovery from the operation. (TTT)

2552 EFFECT OF LOSS OF BLOOD ON THE COURSE OF RADIATION SICKNESS IN ANIMALS. V. N. Pravetskiĭ. Trudy Vsesoyuz. Konf. Med. Radiol., 101-7(1957). (In Russian)

The mortality of a control group of ten dogs was 90% after being given a dose of 350 r on four sides by x rays. When 10% of the blood supply was withdrawn immediately after irradiation, the mortality was 80%. It was 60% after withdrawing 20% of the blood supply. However, on irradiating with γ rays (Co^{60}) with a dose of 550 r from one side, the mortality was 45% for the control group and 70% for dogs from which 20% of the blood was removed immediately after irradiation. This contradiction may be due to the difference in hardness of the radiation or to the possibility of large variations in the survival of animals subject to a high dose. Removal of one-third of the volume of the circulating blod of apparently healthy animals that survived severe radiation sickness showed that the fall in arterial blood pressure was greater (61 to 70% compared to a 33% drop for a healthy animal), the blood flow was slower (by 2.2 to 3.8 sec one hour after the blood letting), the blood sugar level was higher, and the reserve alkalinity of the blood was lower (by 30% in dogs irradiated $1\frac{1}{2}$ months previously). These data indicate the need for caution in operating upon people who have only recently recovered from radiation sickness. (TTT)

2553 TREATMENT OF RADIATION SICKNESS COMPLICATED BY LOSS OF BLOOD. M. Ya. Chaĭkovskaya, O. S. Sergel, G. N. Elpat'evskaya, and S. L. Petrosyan. Trudy Vsesoyuz. Konf. Med. Radiol., 108-12(1957). (In Russian)

Removal of 400 to 600 ml of blood before the irradiation of dogs (14 to 20 kg weight) with a dose of 500 r resulted in a rather light form of radiation sickness. The leukopenia with a minimum leukocyte count of 4000 per mm^3 on the 18th to 20th day lasted only a short time. Removal of 400 to 600 ml of blood 12 hr after irradiation resulted in death in the majority of cases on the 14th to 16th day after irradiation with a complete disappearance of reticulocytes on the 5th day. Removal of 250 to 300 ml of blood 12 hr after irradiation with replacement by donor blood and the application of antibiotics and vitamin B_{12} resulted in a light form of radiation sickness. A control group which did not receive any donor blood or antibiotics suffered from a more severe form of radiation sickness. The reticulocyte count in the peripheral blood of the treated dogs was observable during the course of the whole experiment and exceeded the initial figure on the 26th day. In the control group the reticulocytes appeared only on the 41st day after irradiation. The leukopenia was mild and lasted only a short time in the treated group of dogs (3300 on the 17th day and 6700 on the 26th day after irradiation), while it was more severe and prolonged in the control group (700 to 1000 counts from the 6th to the 27th day after irradiation). The use of a protein concentrate had a favorable influence on the hematopoietic function. An enlarged spleen was observed in all the animals treated with serum, antibiotics, and vitamins. Cytological smears of the spleen showed the presence of numerous erythroblasts and pointed to the development of a compensatory hematopoietic function in the spleen. (TTT)

2554 REGENERATION OF SERUM PROTEINS AFTER LOSS OF BLOOD IN IRRADIATED DOGS. V. M. Rodionov, V. D. Uspenskaya, and O. G. Zamyatkina. Trudy Vsesoyuz. Konf. Med. Radiol., 112-19(1957). (In Russian)

Blood letting equivalent to 5 to 5.5% of the body weight was performed 1, 3, 6, and 45 days after irradiating dogs with a dose of 500 r, and Ringer's solution ($1\frac{1}{2}$ to 2 times the volume of the blood removed) was injected into the femoral vein. The animals least able to survive a loss of blood were those subjected to blood letting six days after irradiation. The volume of circulating plasma determined by the dyestuff T-1824 exceeded the initial volume by 25% three days after the blood letting and decreased thereafter in the control group, but continued to rise slowly in the irradiated group until the death of the animal. In the unirradiated animals regeneration of the volume of blood took place by an increase in the number of erythrocytes with a decrease in plasma volume, while in the irradiated animals the number of erythrocytes continually decreased and the plasma volume remained the same or increased. In the unirradiated group the blood albumin rose to 80% of its initial value after the 1st day and then increased slowly until it reached the original value on the 10th day after blood letting. In the group subjected to radiation there was a rapid rise of blood albumin to 80% of the initial value, but then the blood albumin fell rapidly to 50 to 60% of the initial value at 10 to 15 days after the blood letting. The blood albumin remained constant at that value. The regeneration of plasma albumin is accomplished by two processes: First by a rapid mobilization of tissue albumin and second by a more gradual process wherein the body synthesizes albumins. In a normal dog the albumin fraction is 48 to 55% of the total plasma protein and the α-globulins are 15 to 18% of the total. The α-globulin fraction rises to 25 to 30% of the total plasma protein in unirradiated dogs after blood letting, and it is 40 to 45% of the total plasma protein in irradiated dogs after blood letting. An increase in the α_2-globulin content to 370% of its initial content was noted in some of the irradiated animals. There is a sharp rise in the γ-globulin content just

before the death of an irradiated animal. It is concluded that radiation disturbs the metabolic processes in the body that synthesize plasma albumins, but this process is reversible, since in animals subjected to blood letting one and one-half months after irradiation the regeneration of plasma proteins follows the same course as that observed in control animals. (TTT)

2555 THE FORMATION OF BONE CALLUS DURING RADIATION SICKNESS. G. P. Nazarishvili, R. Ya. Vepkhvadze, T. A. Vakhtangashvili, and K. T. Garsiashvili. Trudy Vsesoyuz. Konf. Med. Radiol., 123-6(1957). (In Russian)

Six dogs were irradiated with an x-ray dose of 408 r, and the shin bone was then broken immediately after radiation. The healing process was followed by x rays in the control group of dogs in which a well-developed bone callus could be observed on the 50th day. No sign of the formation of a bone callus at the fracture site could be observed in any of the irradiated dogs. Even on the 102nd day after the fracture a wide slit could be seen on the x-ray diagram at the point of fracture where the bones had not knit together in the irradiated dogs. (TTT)

2556 THE MORPHOLOGY OF THE HEALING OF A SUTURED SURGICAL WOUND OF THE SOFT TISSUES IN SUBACUTE RADIATION SICKNESS. N. V. Belokonskaya. Trudy Vsesoyuz. Konf. Med. Radiol., 126-9(1957). (In Russian)

White rats irradiated with an x-ray dose of 685 r were cut on the soft tissues of the shank 1 to 1½ hr after irradiation. Necrosis on the walls of the wound was observable at the end of the first day. Edema of the wound was distinctly noticeable on the 3rd day. Resorption of the necrotic muscle fibers began to take place, but new dystrophy and necrotic changes in the muscle fibers as well as new bleeding sites were noted on the walls of the wound. A leukocyte barrier between the healthy and necrotic tissues was hardly noticeable in the irradiated animals. Extensive necrotic changes of the muscle tissues in the vicinity of the wound were noted in numerous irradiated animals who died on the 9th to 10th day after irradiation. Healthy connecting tissue was noticed in the wound of the animals who recovered from the radiation sickness. (TTT)

2557 THE EFFECT OF DECREASED BAROMETRIC PRESSURE ON THE COURSE OF RADIATION SICKNESS IN WHITE RATS. M. M. Mikhaĭlov. Trudy Vsesoyuz. Konf. Med. Radiol., 137-40(1957). (In Russian)

A number of rats were irradiated at a dose of .00 r and maintained in a chamber at a pressure corresponding to that at an altitude of 5000 m above sea level. Three sets of controls were used. One set was irradiated and maintained at the usual pressure. The second set was not irradiated, but was maintained at reduced pressure. The third set of controls was not irradiated and was maintained at the usual pressure. The death of irradiated rats that were maintained at reduced pressure began on the third day after irradiation compared to the 7th day for irradiated rats maintained at the usual pressure. Pathological investigation of the organs of irradiated rats maintained at reduced pressure showed signs of numerous hemorrhagic disorders. On acclimating normal rats to the reduced pressure, leukocytosis, lymphocytosis, and neutropenia were observed in the first ten days. While the neutropenia increased, the number of lymphocytes returned to normal and the number of monocytes did not change in the next 10 days. A slight lymphocytosis and a sharp neutropenia were observed in irradiated rats that were previously acclimatized to the reduced pressure. Lymphopenia and neutrophilia were observed in irradiated rats that were not previously acclimatized to the reduced pressure. (TTT)

2558 THE DISTRIBUTION OF RADIOACTIVE PHOSPHOROUS IN INJURED BONE DURING RADIATION SICKNESS. A. G. Zemlyanoĭ. Trudy Vsesoyuz. Konf. Med. Radiol., 141-2(1957). (In Russian)

Rabbits subjected to an x-ray dose of 800 r were treated with 0.8 mc of P^{32} per kg of body weight. Unirradiated rabbits treated with a dose of 0.8 mc of P^{32} per kg served as controls. The radius in both groups of rabbits was fractured and the accumulation of P^{32} in the bone was determined by autoradiograms. Observations were also made on the distribution of P^{32} in normal rabbits. The accumulation of P^{32} in the fractured radius of unirradiated rabbits was one-third greater than it was in the normal rabbit. The amount of P^{32} in the fractured bone was one-third greater for the irradiated rabbits than it was for the rabbits that were not irradiated. The P^{32} concentrates primarily in the callus that is being formed and in the cartilage of the epiphysis. (TTT)

2559 DELAYED RESULTS OF SEVERE RADIATION SICKNESS IN DOGS. I. N. Usacheva. Trudy Vsesoyuz. Konf. Med. Radiol., 145-8(1957). (In Russian)

Nineteen dogs which survived a dose of 600 r and 3 dogs which survived a dose of 800 r were subjected to clinical observation from 6 to 22 months after irradiation. In 4 to 6 months a gradual re-establishment of the hematopoietic function was observed. In 7 out of 22 dogs this normalization of erythropoiesis was preceded by an increase in size of the erythroblasts of the bone marrow as well as by an increase in the number of thrombocytes. However, even 12 to 18 months after irradiation, there were wide variations in the thrombocyte count. The leukocyte count was normal in only 4 to 16 animals 9 months after irradiation; the count was 3000 to 6000 instead of 9000 to 15,000 even 12 months after irradiation; and the count did not return to normal in 2 dogs irradiated with a dose of 800 r even after 18 months. Pathological changes due to the action of ionizing radiation were observed in various organs after sacrificing 10 of the dogs at 8, 9, 10, and 13 months after irradiation, and subjecting them to autopsy. Thirty-four puppies that were born of the irradiated dogs could not be distinguished in any way from normal healthy puppies. (TTT)

2560 THE REACTION OF IRRADIATED ANIMALS TO ANESTHETICS. G. M. Gorban. Trudy Vsesoyuz. Konf. Med. Radiol., 164-9(1957). (In Russian)

Hexanol, ether, chloroform, nitrous oxide, and a combination of hexanol with Novocain or nitrous oxide were used as anesthetics on animals at various periods of radiation sickness. The sensitivity of irradiated animals to hexanol and ether was significantly increased with an increased death rate during the latent period and the climax of the radiation sickness. The sensitivity to chloroform was even greater than that for ether. A single administration of nitrous oxide as an anesthetic during the latent period or the climax did not complicate the course of the radiation sickness. Nitrous oxide did not lower the arterial blood plasma. (TTT)

2561 COMPLICATIONS DURING RADIATION THERAPY AND THEIR TREATMENT. M. P. Domshlak, Yu. G. Grigor'ev, N. G. Darenskaya, L. B. Koznova, and G. F. Nevskaya. Trudy Vsesoyuz. Konf. Med. Radiol., 170-4 (1957). (In Russian)

Radiation sickness developed in 277 out of 313 people (89%) irradiated locally at doses of 200 to 300 r for a total local dose of 6000 to 8000 r, and in 40 out of 41 people (98%) irradiated over the entire body in doses of 25 r for

a total whole-body irradiation of 200 r. Leukopenia with a decrease in leukocytes to 1500 to 2000, lymphopenia, thrombocytopenia, monocytosis, a slight eosinophilia, and sometimes a shift to the left were observed in the majority of cases. There was a tendency to a lower arterial blood pressure, especially in people with high blood pressure. Nicotinic acid (0.02 g dose 3 to 4 times per day) ameliorated the more severe symptoms of radiation sickness such as nausea and vomiting. Aeron was ineffective. Urotropine (0.5 g dose 3 to 5 times per day) had a favorable effect on the state of health of the patient, but did not improve the blood picture. Caffeine (0.1 g dose twice per day) and tezan (10 drops of a 5% alcoholic solution three times per day) had favorable effects in preventing the development of leukopenia. Pentoxyl, a pyrimidine derivative, temporarily increased the absolute number of neutrophils in a person with persistent leukopenia, but the effect was not permanent. A mixture of the methyl esters of linolenic, linoleic, and amino acids was found to promote epithelization of injured skin in 2 to 9 days compared to 9 to 25 days in the controls. (TTT)

2562 TRUDY VSESOYUZNOĬ KONFERENTSIIA PO MEDITSINSKOĬ RADIOLOGII. KLINIKA I TERAPIYA LUCHEVOĬ BOLEZNI. (Proceedings of the Conference on Medical Radiology. Clinical Aspects and Therapy of Radiation Sickness). A. V. Kozlova, ed. Moscow, Gosudarstvennoe Izdatel'stvo Meditsinskoi Literatury, 1957. 323p.

Seventy-seven papers on the clinical aspects and therapy of radiation sickness and diagnostic tracer applications are included. Twenty-nine of the papers are covered by separate abstracts. (M.C.G.)

CHEMISTRY

General and Miscellaneous

2563 (CF-60-10-26) SYNTHESIS OF DIMETHYL SELENIDE. J. C. White and H. L. Holsopple, Jr. Oak Ridge National Lab., Tenn. Oct. 7, 1960. 3p. OTS.

The preparation of essentially pure dimethyl selenide is described. The compound was prepared by warming a mixture of selenium, sodium hydroxide, and sodium formaldehyde sulfoxylate in aqueous solution for several hours at 50°C and then adding methyl iodide. Dimethyl selenide was removed by distillation. (auth)

2564 (LMSD-703005) NITROGEN FLUORIDES AND THEIR ORGANIC DERIVATIVES. A LITERATURE REVIEW. C. J. Hoffman and R. G. Neville. Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif. Aug. 1960. 36p. OTS.

A review of the unclassified literature on the binary compounds of nitrogen and fluorine and their organic derivatives is presented. Physical and chemical properties are discussed along with preparation methods. (auth)

2565 (NAA-SR-5687) THE COMPATIBILITY OF KEROSENE WITH SODIUM IN A CLOSED SYSTEM TO 1200°F. G. M. Wolten and R. A. Meyer. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Nov. 1, 1960. 15p. Contract AT-11-1-GEN-8. OTS.

The purpose of this investigation was to ascertain the suitability of kerosene or kerosene-like materials as coolants for sodium freeze seals in sodium-cooled nuclear reactors. The following facts were established. Different kerosenes are of different chemical composition, resulting in markedly different behavior toward sodium and heat. Certain possible constituents of kerosene form air-reactive compounds with sodium. The concentration of these ingredients was found to be very small in one type of kerosene and larger in another. Clues to the nature of these ingredients were obtained, and a possible method of eliminating them was suggested. The thermal stability of paraffins appears to be higher for branched than for straight-chain structures. In order to arrive at a specification for a safe type of kerosene to use in the intended application, the chemical composition of kerosenes would have to be established in greater detail. It seems entirely feasible, and it is recommended, that a suitable kerosene be selected on the basis of empirical tests similar to those developed in this work. (auth)

2566 (NP-9417) CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH PROGRAM. Third Quarterly Progress Report [for period] July 1, 1960–September 30, 1960. J. A. Coffman, G. M. Kibler, and T. R. Riethof. General Electric Co. Flight Propulsion Lab. Dept., Cincinnati. Sept. 30, 1960. 43p. Project No. 4776. Contract AF33(616)-6841.

The efforts applied to and the results obtained from investigations of (1) the rate and mechanism of plastics carbonizations, (2) the vapor pressures of refractory materials, and (3) the spectral emissivities of refractory materials are summarized. Work has progressed on each of the three complementary approaches used in studying the carbonization of plastics. Results from thermogravimetric studies of the process have shown that carbon yields from molded buttons of a phenolic resin and a polyphenylene plastic are greater than from loose powders of these same plastics. Arc-image furnace experiments were conducted with molded buttons of a strongly cross-linked polyethylene, polyphenylene, polynaphthalene, and phenolic resins separately reinforced with titanium power, tantalum power and niobium turnings. Results show that the polyethylene did not carbonize and that the coke layer formed with reinforced phenolic is denser than from straight phenolic. Differences in analysis of gaseous products from polyphenylene and polynaphthalene are given. Vapor-pressure studies by Langmuir evaporation continue. Work on ZrC is nearly complete; studies with WC have been initiated. Results of ZrC vaporization show excellent agreement with values calculated from low-temperature thermodynamic functions. Emissivity work was devoted primarily to W-2 coated molybdenum and to siliconized ATJ graphite. Emissivities are given for these materials at various temperatures over the wavelength of 1 to 6 μ. (For preceding period see AD-236160.) (auth)

2567 (SCR-187) DICHLOROBENZIDINE AS A CURING AGENT FOR ADIPRENE L-100. A. J. Quant. Sandia Corp., Albuquerque, N. Mex. Sept. 1960. 14p. OTS.

A cast polyurethane elastomer with exceptional physical properties was obtained by curing the prepolymer Adiprene L-100 with dichlorobenzidine. This system proved to be valuable in applications requiring a casting resin of extreme thermal-shock resistance. (auth)

2568 (TID-6791) ANALYTICAL CHEMISTRY OF THE POLYPHOSPHATES. William Rieman, III. Rutgers Univ., New Brunswick, N. J. Oct. 18, 1960. 10p. Contract AT(30-1)-1306. OTS.

An investigation was conducted to develop methods for determining the molecular composition of condensed phosphate mixtures. A satisfactory method was established for determination of total cyclic polymers and total linear polymers in mixtures of the two types. (J.R.D.)

2569 (WAPD-BT-20(p.83-90)) MATHEMATICAL DESCRIPTION OF THE TRANSIENT BEHAVIOR OF A FIXED BED ION-EXCHANGE SYSTEM FOR REMOVAL OF RADIOACTIVE MATERIAL. A. S. Kesten. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

A solution is presented to the general problem of the transient behavior of a fixed-bed ion-exchange system in which the rate of exchange is determined by the combined effects of a liquid film, solid diffusion into spherical particles and radioactive decay. The solution permits prediction of the ratio of effluent to influent concentration of a radioactive nuclide as a function of time, given this same functional relationship for the nuclide's nonradioactive isotope. Rosen has developed equations which can be employed to describe this latter relationship, provided the solid-diffusion coefficient, liquid-film resistance, and distribution coefficient are known, and methods were developed for evaluating these parameters from a series of simple experiments. (auth)

2570 (AEC-tr-4239) STUDY OF THE COMPLEX-FORMATION OF AM^{+3} WITH OXALATE IONS. I. A. Lebedev, S. V. Pirozhkov, V. M. Razbitnoi, and G. N. Yakovlev. Translated by Thomas K. Keenan and Helen J. Chick (Los Alamos Scientific Lab.) from Radiokhimiya 2, 351-6(1960). 15p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 21474.

2571 (AEC-tr-4286) INVESTIGATION OF THE PROCESS OF THERMAL DISSOCIATION OF MOLYBDENUM HEXACARBONYL. 1. DEPENDENCE OF THE RATE OF THE HETEROGENEOUS PROCESS ON TEMPERATURE AND ACTIVATION ENERGY. A. A. Rozen. Translated by Lydia Venters (Argonne National Lab.) from Ukrain. Khim. Zhur. 25, 735-8(1959). 6p. JCL or LC.

The dependence of the rate of the heterogeneous process of the thermal dissociation of molybdenum hexacarbonyl on temperature in the range from 150 to 950°C was investigated. The maximum rate of the thermal dissociation on the surface was found to be at 720 to 750°C. The maximum deposition rate of molybdenum on the surface within the investigated limits does not depend either on hydrogen pressure or concentration of carbonite. (W.L.H.)

2572 (AEC-tr-4301) RELAXATION MECHANISM OF PROPAGATION OF BURNING IN HETEROGENEOUS EXOTHERMIC SYSTEMS. [PART] II. Z. I. Fur. Translated by Lydia Venters (Argonne National Lab.) from Zhur. Fiz. Khim. 34, 1299-1306(1960). 13p. JCL.

A discussion of pressure and initial temperature effects on the relaxation mechanism of burning propagation velocity in exothermic heterogeneous systems is presented. A model is proposed which corresponds partially to the physical processes which take place in such systems. It is noted that the hypothesis contains a number of assumptions that do not have sufficient backing, and further development is required before unlimited use may be made of it. (J.R.D.)

2573 (AEC-tr-4307) DIFFUSION OF GASES UNDER PRESSURE. (Diffuziya Gazov pod Davleniem). V. V. Ipat'ev (Ipatiev, Jr.) and V. I. Tikhomirov (Tihomirov). Translated from Zhur. Obshcheĭ Khim. 1, 736-9(1931). 12p. (Includes original, 4p.). JCL or LC.

The measurement of the diffusion of a gas in a liquid under pressure is discussed. The diffusion of hydrogen in H_2O, CH_3OH, C_6H_6, and a 20% NaOH solution under pressure was measured. (C.J.G.)

2574 (AWRE-Trans-11) SENSITISATION OF GELATIN DYNAMITES BY MEANS OF INERT ADDITIVES. L. Avogadro. Translated by F. E. Wallwork from Ann. chim. (Rome) 49, 352-7(1959). 8p.

Certain nonexplosive substances are known to have a sensitizing effect on gelatin dynamites in that they promote high-velocity detonation despite aging or high hydraulic pressures. The causes of this action are examined and the importance of hardness and density are shown. The exceptions due to the solubility and reactivity of the surveyed compounds are pointed out. A theory for the mechanism of these inert additives is offered. (auth)

2575 (UCRL-Trans-572(L)) ON THE PRECIPITATION OF TIN WITH PHENYLARSONIC ACID. V. I. Kuznetsov. Translated from Zhur. Priklad. Khim. 13, 1512-16(1940). 11p. JCL or LC.

The relations of α and β compounds of tetravalent tin in solution to phenylarsonic acid were studied. It was found that tetravalent tin must be in the form of a metastannic chloride to precipitate with phenylarsonic acid. It was also noted that in all cases studied the β form of tin precipitates better than the α form. (J.R.D.)

2576 HYDROGEN AND DEUTERIUM EXCHANGE OF POLYPROPYLENE. L. C. Case and J. D. Atlas (Purdue Univ., Lafayette, Ind.). J. Polymer Sci. 45, 435-42(1960) Aug.

"Isotactic" and "atactic" polypropylenes in cyclohexane solution were exchanged with hydrogen and deuterium in the presence of a large-pore-size nickel–kieselguhr catalyst. The resulting polymers were freed from catalyst, precipitated, and pressed into films, and the density and stiffness were determined. If the "isotactic" polymer were actually stereoregular, it would be expected from studies of model compounds that racemization of the tertiary carbon atoms in the chain would occur upon exchange. The racemization of the polymer would lead to a less "isotactic" polymer and a drop in density and stiffness. The deuterium content of the polymer was determined by the refractive index of the water of combustion. The exchange values were as high as 3.0%. If all this deuterium were in the tertiary positions, about 18% of the tertiary carbons in the chain would be racemized. However, no detectable loss of stiffness or density occurred. This work failed to confirm the theory of isotacticity. The results, although not conclusive, seem to cast doubt on the theory. (auth)

2577 A MASS SPECTROMETRIC DEMONSTRATION OF HYDROGEN-DEUTERIUM EXCHANGE AND HYDROGEN REDISTRIBUTION DURING CATALYTIC DEUTERATION OF SOME METHYL OCTADECENOATES. Nguyen Dinh-Nguyen (Univ. of Göteborg) and Ragnar Ryhage. J. Research Inst. Catalysis, Hokkaido Univ. 8, 73-7(1960) July. (In English)

An investigation was made of the addition reaction, the hydrogen-deuterium exchange reactions, and the hydrogen redistribution phenomenon in the catalytic deuteration of methyl oleate and methyl cis-petroselinate. The experiments showed that addition of the deuterium atoms to the double bond may take place faster than the exchange between them and an acid solvent; thus the chemisorbed deuterium used for the reduction is not in equilibrium with the liquid phase. All deuterations, in neutral as well as in ionic media, led to the formation of both methyl stearate and methyl monodeuterostearate. (M.C.G.)

2578 ORGANIC CO-PRECIPITATOR. XIV. AN IMPROVED METHOD OF URANIUM PRECIPITATION FROM GROUND WATERS. V. I. Kuznetsov and T. G. Akimova. Radiokhimiya 2, 426-30(1960). (In Russian)

Quantitative precipitation of 0.02 g of uranium per liter of sea or river water at a pH not exceeding 3 to 3.5 was achieved with methyl violet rhodanide. At pH ~4.5 the precipitation reaches ~80%. Quantitative coprecipitation at pH 7.8 to 8.6 was also achieved by the combined application of sodium diethyldithiocarbaminate, ammonium rhodanide, and methyl violet. Various methods of uranium coprecipitation from acidified and nonacidified natural waters are discussed. A method is developed for preparing assay samples for fluorometric determination of uranium. (R.V.J.)

2579 IMPROVEMENTS IN OR RELATING TO THE COLD SEPARATION OF GAS MIXTURES. (to Commissariat à l'Énergie Atomique). British Patent 851,190. Oct. 12, 1960.

An improved method for purifying hydrogen from impurities such as nitrogen is presented in which the gas is passed through a heat exchanger at a low temperature so that impurities are deposited and then through an absorbent to complete the purification. Means are provided for the regeneration of the absorbent without interrupting the purification process. (D.L.C.)

Analytical Procedures

2580 (AERE-AM-60) COLLECTED LABORATORY PROCEDURES FOR THE DETERMINATION OF RADIOELEMENTS IN URINE. R. O. R. Brooks, comp. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Aug. 1960. 34p. BIS.

Working details of procedures for the determination of Am, I, Pu, Po, Ra, fission products, tritium, and U in urine are presented. (J.R.D.)

2581 (AERE-AM-71) THE DETERMINATION OF RADIOZIRCONIUM IN SOLUTIONS CONTAINING SODIUM. G. J. Hunter. United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England. Sept. 1960. 4p. BIS.

Exchange is established between radiozirconium and zirconium carrier in a solution containing fluoride and ethylenediamine tetraacetic acid at a pH between 4 and 6. After precipitating and redissolving zirconium phosphate, the rare-earth and alkaline-earth activities are removed by precipitating lanthanum fluoride. The remainder of the analysis is carried out in accordance with the procedure in AERE-AM-67. (auth)

2582 (ARL-TR-60-286) REACTION OF 1-(2-PYRIDYLAZO)-2 NAPHTHOL WITH THE METALS OF PERIODIC GROUPS IVa, Va, VIa, AND THEIR ANALYTICAL APPLICATIONS. [Period covered]: December 22, 1956 to April 30, 1960. Fred W. Staten and E. W. D. Huffman. Huffman Microanalytical Labs., Wheatridge, Colo. June 1960. 49p. Project No. 7364. Contract AF33[616]-3964.

1-(2-pyridylazo)-2 naphthol was found to react with all of the elements of Periodic Groups IVa, Va, and VIa under appropriate conditions. An analytical method was developed for the determination of vanadium in various types of materials. End measurement procedures were developed for the determination of zirconium, hafnium, and niobium. Possible procedures for the determination of zirconium and hafnium in the same sample are discussed as well as a like scheme for niobium and tantalum. The properties of the reagent and some of the chelates were studied relative to solubilities, stability toward various solvents and reagents, thermal stability, elemental composition, possible structure, and absorbance of light in the ultraviolet, visible, and infrared regions of the spectrum. Titrimetric methods for vanadium and zirconium employing EDTA as the titrant and PAN as the indicator were investigated briefly. (auth)

2583 (CF-57-6-64) SPECTROPHOTOMETRIC DETERMINATION OF CERIUM WITH TIRON. B. L. McDowell, A. S. Meyer, Jr., and J. C. White. Oak Ridge National Lab., Tenn. June 14, 1957. 20p. OTS.

A spectrophotometric method for the determination of cerium and Tiron (disodium-1,2-dihydroxybenzene-3,5-disulfonate) was applied to the determination of cerium in samples which contain uranium and zirconium. The cerium-Tiron complex in solutions of pH 8 or greater exhibits an absorption maximum of 500 mμ. This reagent does not react with any other lanthanide element. The interference of iron, uranium, and zirconium was eliminated by extracting these interfering elements with a solution of trioctylphosphine oxide in cyclohexane. (auth)

2584 (CF-59-4-40) DETERMINATION OF TETRAVALENT URANIUM IN THORIUM OXIDE–URANIUM OXIDE MIXTURES. PARTS I, II, AND III. Oscar Menis. Oak Ridge National Lab., Tenn. Apr. 7, 1959. 9p. OTS.

For the determination of milligram quantities of uranium(IV) in thorium oxide–uranium oxide mixtures which may also contain uranium(VI), it was necessary to devise a means of dissolving the sample so as to prevent any air oxidation of the uranium(IV) to uranium(VI). For this determination, the conventional potassium dichromate volumetric method was used except that the sample was dissolved under reflux in 7 M H_3PO_4 which contained an excess of standard dichromate solution. Following the dissolution of the sample, this excess was determined by back titration with a standard solution of iron(II). Barium diphenylaminesulfonate was used as the indicator. Initial tests on the dissolution of samples of thorium oxide–uranium oxide in hot $HClO_4$ and hot HCl are described. (auth)

2585 (CF-60-10-38) DETERMINATION OF FREE ACID IN HIGHLY RADIOACTIVE SOLUTIONS BY REMOTELY CONTROLLED CONDUCTOMETRIC TITRATION. R. E. Corcoran, H. E. Zittel, S. R. Dinsmore, and U. Koskela. Oak Ridge National Lab., Tenn. Oct. 13, 1960. 9p. OTS.

A conductometric titration method described by Goldstein was adapted for use in a remote analytical facility. The results obtained by means of experiments made prior to this adaptation indicated that methanol is the most satisfactory medium in which to determine excess sulfuric acid in uranyl sulfate solutions that simulate homogeneous reactor type fuel. When methanol is used, the complexation of hydrolyzable ions with sodium fluoride, as described by Pepkowitz, Sabol, and Dutina, is not required. (auth)

2586 (CRDC-958) THE DETERMINATION OF ARSENIC IN BIOLOGICAL MATERIALS. W. D. Mackintosh and R. E. Jervis. Atomic Energy of Canada Ltd., Chalk River, Ont. Aug. 1960. 14p. (AECL-1083). AECL.

Sensitive methods for determination of arsenic in biological material are of interest to practitioners of medical jurisprudence. A neutron-activation method, which is more sensitive than the usual Gutzheit test is described. Results are given for five arsenic poisoning cases, which were investigated and compared with those for healthy controls obtained at the same time. The results are also compared with those obtained by others. (auth)

2587 (KAPL-2000-11(p.I.1-I.2)) ANALYSIS OF TANTALUM AND LUTETIUM IN IRRADIATED HAFNIUM.

R. F. Dufour. Knolls Atomic Power Lab., Schenectady, N. Y.

A method was developed for the analysis of tantalum and lutetium in irradiated hafnium. This determination begins with a CaF_2 carrier precipitation to separate the rare earths from tantalum and hafnium. Lutetium is determined flame-photometrically by burning the TTA-hexone extract of a fluoride-free buffered solution in an oxyacetylene flame. Tantalum is separated from hafnium by solvent extraction with hexone. The tantalum is back-extracted into a dilute hydrogen peroxide solution and then determined colorimetrically. (W.L.H.)

2588 (KAPL-2000-11(p.I.18-I.20)) CHEMICAL PROCESSING OF BORON-CONTAINING SAMPLES FOR ISOTOPIC ANALYSIS. V. F. Consalvo. Knolls Atomic Power Lab., Schenectady, N. Y.

The method for the separation of B from neutron-irradiated B_4C, B_4C–Zircaloy, and B_4C–Al_2O_3 was developed to prepare samples suitable for isotopic analysis by means of a solid mass spectrophotometer. The sample is fused with Na_2CO_3 and then cooled, and the melt is subsequently dissolved and neutralized with HCl. The solution is filtered and diluted to a known volume. An aliquot of the solution is evaporated with NaOH and thus converted to sodium metaborate. (W.L.H.)

2589 (KAPL-2000-11(p.I.20-I.26)) VOLTAMMETRIC CHLORIDE ION ANALYSIS. W. N. Carson and G. R. Fountain. Knolls Atomic Power Lab., Schenectady, N. Y.

The basic section of the apparatus is an electrolysis cell composed of the silver cylindrical microelectrode and the platinum cylindrical counterelectrode. A constant current in the microampere range is passed the cell; the current is supplied from a constant-current source. The potential of the silver electrode serves as the measure of the chloride content. This potential is measured with the reference electrode and the vacuum voltmeter. Tests were run on synthetic samples containing known amounts of chloride ion. Results are summarized. (W.L.H.)

2590 (KAPL-2000-11(p.I.27-I.29)) CHEMICAL ANALYSIS OF STAINLESS STEEL CORROSION PRODUCTS. J. R. Ciaranello and K. E. Combs. Knolls Atomic Power Lab., Schenectady, N. Y.

Stainless-steel corrosion products essentially are mixtures of metallic oxides, chiefly Fe_3O_4. In addition to iron, the elements of interest are nickel, chromium, manganese, and cobalt, and, to a lesser extent, zirconium, copper, and zinc. Colorimetric procedures for the determination of all these elements were studied and evaluated, and a synopsis of the procedures is presented. (W.L.H.)

2591 (KAPL-2000-11(p.II.1-II.8)) THE SPECTROGRAPHIC DETERMINATION OF CADMIUM, HAFNIUM AND RARE EARTHS IN BORON CARBIDE. D. A. Del Grosso. Knolls Atomic Power Lab., Schenectady, N. Y.

Emission-spectrographic methods applicable for the determination of small amounts of cadmium, hafnium, and certain rare-earth impurities in boron carbide are described. The procedure involves the separation of the rare earths and a yttrium carrier from the sample by ammonia and fluoride precipitations. The cadmium and hafnium are isolated in the fluoride solution following the final precipitation of the rare earths. The rare earths are determined spectrographically as impurities in yttrium, and the cadmium and hafnium as impurities in sodium. (auth)

2592 (KAPL-2000-11(p.II.8-II.12)) THE INFRARED DETERMINATION OF DITERTIARY-BUTYL-PARACRESOL OXIDATION INHIBITOR IN TURBINE OIL. F. P. Landis. Knolls Atomic Power Lab., Schenectady, N. Y.

A method is described which is suitable for the estimation of DBPC additive in highly refined mineral oils. Since all such oils are quite similar in their organic make-up, no interferences are to be expected in the identification or estimation of the additive, especially when unused oils or base stocks are available for comparison by the differential infrared technique. The smallest difference in concentration that can be conveniently detected and measured is 0.1% DBPC by weight. From measurement of the absorbance-difference values used for points of the standard curve, the method gives a precision of approximately 0.01% DBPC over the range 0.1 to 1.0%. It is expected that further work with 1.0-mm path-length absorption cells will improve both sensitivity and precision for this determination. (auth)

2593 (NP-9437) MÉTODO ESPECTROSCÓPICO SEMICUANTITATIVO DE WARING Y ANNEL APLICADO A INSTRUMENTOS DE DISPERSIÓN MEDIA. INFORME NO. 24. (The Semiquantitative Spectroscopic Method of Waring and Annell Applied to Instruments with Dispersion Media. Report No. 24). A. Giachetti. Argentina. Comisión Nacional de Energía Atómica, Buenos Aires. 1959. 19p.

A description is given of an application of the semiquantitative method of Waring and Annell to prism spectrographs. The method is applied to 60 elements; the preparation of standards and samples is described. Using a Hilger quartz-prism spectrograph model E.492, all the lines from 2500 to 3500 A were scanned, and their respective sensitivities were determined. The spectra of the alkali metals and alkaline earths were photographed in the visible region to obtain better sensitivity. (tr-auth)

2594 (PG-Report-141) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF FLUORIDE IN MILK. United Kingdom Atomic Energy Authority. Production Group. Springfields, Lancs, England. 1960. 8p. BIS.

The milk is first ashed, and the fluoride is then separated by steam distillation. The fluoride is determined absorptiometrically using the aluminum solochrome cyanine complex. (auth)

2595 (PG-Report-155) ANALYTICAL METHODS FOR THE DETERMINATION OF CAESIUM-137, STRONTIUM-89, AND -90 IN RAIN, LAKE AND SEA WATER. United Kingdom Atomic Energy Authority. Production Group. Windscale, Sellafield, England. 1960. 19p. BIS.

Radiostrontium and cesium together with added carriers are coprecipitated on larger amounts of calcium and potassium, respectively. After radiochemical purification the β activities due to Sr^{89} and Cs^{137} are measured. Yttrium-90 is allowed to grow in; then it is separated and the activity is measured to determine the Sr^{90} content. The method is suitable for the determination of Cs^{137}, Sr^{89}, and Sr^{90} in the same sample portion and is therefore particularly useful when the sample size is limited or when the concentrations of the isotope are very low. Large samples (40 to 50 liters) can be handled without resorting to tedious evaporation techniques. Detection limits are governed by natural background radiation which is dependent upon local conditions. The method has been applied however to samples containing 2 to 1500 $\mu\mu c$ Cs^{137}; 20 to 5000 $\mu\mu c$ Sr^{89}, and 1 to 1000 $\mu\mu c$ Sr^{90} per sample portion. (auth)

2596 (USNRDL-TR-451) ANALYTICAL PROCEDURES AT THE U.S. NAVAL RADIOLOGICAL DEFENSE LABORATORY FOR THE DETERMINATION OF CERTAIN

RADIOELEMENTS IN URINE. W. H. Shipman and H. V. Weiss. Naval Radiological Defense Lab., San Francisco. July 7, 1960. 26p.

Analytical procedures are described for the determination of the following radioactivities in urine: gross β activity, Ba^{140}, Sr^{90}, plutonium, polonium, radium, and natural uranium. (auth)

2597 (WAPD-T-1219) DETERMINATION OF BORON IN NUCLEAR REACTOR MATERIALS USING PYROHYDROLYSIS TECHNIQUES. V. R. Wiederkehr and G. W. Goward. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh. June 1960. 29p. Contract AT(11-1)-GEN-14. OTS.

To be presented at the Fourth Conference on Analytical Chemistry in Nuclear Reactor Technology and First Conference on Nuclear Reactor Chemistry on October 12–14, 1960.

A method was developed for quantitative separation of micro and macro amounts of boron from a variety of materials. The method appears to have universal application with procedure modifications for different matrices for any material which will release boron on pyrohydrolytic treatment. (J.R.D.)

2598 (Y-1320) THE DETERMINATION OF TRACE QUANTITIES OF ZINC IN LITHIUM CHLORIDE BY DERIVATIVE POLAROGRAPHY. J. H. Rowan. Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn. Oct. 5, 1960. 19p. Contract W-7405-eng-26. OTS.

A method of analysis is presented for the derivative polarographic determination of zinc in LiCl. As little as 10 μg Zn/g Li were determined to ±15% of the amount present. (auth)

2599 (Y-1321) THE CONDUCTOMETRIC DETERMINATION OF CARBON IN BERYLLIUM. E. M. Massey. Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn. Oct. 10, 1960. 21p. Contract W-7405-eng-26. OTS.

A method of analysis for trace quantities of carbon in beryllium is described which involves combustion of the sample together with accelerators in an oxygen atmosphere using an induction type furnace. Carbon, released as CO_2, is measured using a BaOH conductivity cell. (auth)

2600 (CEA-tr-A-713) MICRODOSAGE PAR TITRAGE PAR L'ACIDE ÉTHYLÈNE–DIAMINE–TÉTRA–ACÉTIQUE. XIV. DOSAGE DES TERRES RARES. (Microdetermination by Titration with Ethylenediaminetetraacetic Acid XIV. Determination of Rare Earths). H. Flaschka. Translated into French from Mikrochim. Acta 1, 55-60 (1955). 12p.

The complexometric titration of several rare earths is described, and three different titration procedures are given. The first involves direct titration at pH 8 to 9 at the boiling point with citric acid and tartaric acid using Eriochrome black T as an indicator. The second procedure is a black-titration of an EDTA excess with a standard solution of zinc at pH 8 to 9, cold, with Eriochrome black T. Also the EDTA excess can be back-titrated at pH 5 with standard zinc and using ferriferrocyanide^{2+}-3,3'dimethylnaphthalidine as redox indicator. The latter method is not affected by alkaline earths. The precision is 0.01 to 0.02 ml; standard precision is 0.01M. (T.R.H.)

2601 (CEA-tr-R-929) EMPLOI DU FILTRE POLARISATEUR D'INTERFÉRENCES POUR L'ANALYSE DE LA COMPOSITION ISOTOPIQUE DES MÈLANGES HYDROGÈNE-DEUTÉRIUM. (Use of an Interference Filter Polarizer for Analysis of the Isotopic Composition of Hydrogen–Deuterium Mixtures). V. A. Borgest and A. N. Zaidel. Translated into French from Optika i Spektroskopiya 5, 686-91(1958). 16p.

A description is given of the use of an interference filter polarizer for analysis of the isotopic composition of an H_2-D_2 mixture. When the mixture contains low deuterium concentrations (<0.1%) the filter serves to cover the hydrogen line. In this case a photographic method is used with a relative error of about 15%. In combination with a visual photometric installation, it is possible to measure with this same filter average concentrations (10 to 90% D_2) with the same precision. In this case it is not necessary to use an apparatus for separating the spectral lines of H_2 and D_2. (T.R.H.)

2602 (UCRL-Trans-573(L)) CRYOSCOPIC TITRATION. M. Usanovich, T. Sumarokova, and Yu. Nevskaya. Translated from Doklady Akad. Nauk S.S.S.R. 98, 617-18 (1954). 6p. JCL or LC.

A method of cryoscopic titration is described for use in quantitative analysis. (C.J.G.)

2603 CONTRIBUTION TO THE QUANTITATIVE DETERMINATION OF Al IN SPECIAL MATERIALS, ESPECIALLY MAGNETIC ALLOYS. W. Dübel and W. Flurschütz Chem. Tech. (Berlin) 12, 538-40(1960) Sept. (In German)

A method is described which permits the quantitative determination of aluminum in special materials in a relatively short time. By the installation of an undistorted magnet in the electrolysis vessel, which is magnetized in the vertical direction, the electrolysis time is reduced to a minimum. (tr-auth)

2604 PAPER CHROMATOGRAPHY OF MOLYBDENUM. APPLICATION TO THE SEMI-QUANTITATIVE DETERMINATION OF THIS ELEMENT IN MINERALS, ROCKS AND SOILS. Henri Agrinier. Compt. rend. 249, 2365-6(1959) Nov. 30. (In French). (CEA-1466)

Molybdenum is extracted by a solvent made up of ammonia and acetone. The chromatogram is developed by "Tiron" for concentrations greater than 100 ppm and by potassium ferrocyanide for concentrations between 100 and 10 ppm. (auth)

2605 DETERMINATION OF THE COMPOSITION OF β EMITTERS BY THEIR ABSORPTION IN ALUMINUM LAYERS. V. L. Anokhin. Radiokhimiya 2, 479-84(1960). (In Russian)

A method is offered for determining the composition of mixed β emitters by absorption in aluminum. Specimens of $(Ce + Pr)^{144}$, $(Sr + Y)^{90}$, and Cs^{134} were used in tests of the method. (R.V.J.)

2606 PROBLEMS AND POSSIBILITIES OF X-RAY FLUORESCENCE SPECTROSCOPY IN THE INVESTIGATION OF ALUMINUM, ESPECIALLY ALUMINUM CASTING ALLOYS. Hermann Kessler and Horst Rammensee (Laboratorium der Aluminiumwerke G.m.b.H., Nuremberg). Z. Metallk. 51, 548-50(1960) Sept. (In German)

Problems are raised when analyzing aluminum and especially aluminum casting alloys by the x-ray spectrographic method as oxide layers reduce the intensity of fluorescence and primary silicon crystals in hypereutectic aluminum-silicon alloys effect breaks in the calibration curves. The paper discusses the possibility of measuring the thickness of oxide layers and of determining the degree of modification by means of x-ray spectrography. (auth)

2607 ISOTOPIC MASS SPECTROSCOPIC ANALYSIS OF BORON BY THE THERMIONIC EMISSION METHOD. A. M. Kolchin, V. F. Malakhov, and G. M. Panchenkov (Moscow State Univ.). Zhur. Fiz. Khim. 34, 2124-5(1960) Sept. (In Russian)

Measurements were carried out with mass spectrometer MC-4 ($R_{ex} = 5 \times 10^{\prime\prime}$ Ω) with an ordinary thermionic source. Ribbons 20 mm long, 0.8 to 1.0 mm wide, and 0.05 to 0.1 mm thick were used as heaters. The ion current increases with increased restorative properties of the ribbon material (Pt, Ni, W, and Ta). The platinum ribbon did not emit $Na_2BO_2^+$ ions. Ion currents of 6×10^{-14} to 5×10^{-3} were recorded from calcined nickel, tungsten, and tantalum ribbons. Additions of magnesium and borax (4:1) to the emitter produced a more intense (10^{-11} A) and stable ion current which enabled an isotopic analysis with an accuracy of 1%. The ratios of B^{11} to B^{10} in the mixture of borax with magnesium powder and in enriched specimens are tabulated. The table shows that the fluctuations of B^{11}/B^{10} ratios are reduced with time, producing a more stable current of $NaBO_2^+$. Consequently, it is recommended that the analysis be carried out 30 min after establishing the required current. (R.V.J.)

2608 INVESTIGATIONS OF SOME ERROR SOURCES IN U–Th DETERMINATIONS BY α-IMPULSE SPECTROMETRY. Carlo L. Garavelli. Italy. Comitato Nazionale per le Ricerche Nucleari, Rome. p.202-35 of "Studi e Ricerche Della Divisione Geomineraria. Volume II, 1959." (In Italian)

The practical application of the α spectrometry to the solution of mineralogical and geochemical problems under routine conditions was studied. For the preparation of the α-emitting thin layers a technique was developed, which is based upon the grinding of the sample in methanolic suspension and the subsequent deposition of the layer from the same liquid. Such a simple and quick technique gives excellent spectral resolution. From the results of several series of determinations carried out on standards with known contents in uranium and thorium, the absence of systematic errors is shown in the absolute estimations of these elements; the coefficient of variation ranges from 3 to 7%. Starting points for such determinations may be either the measurements of the areas under the peaks in the counts per channel as a function of energy plots, or the total number of counts read on the scaler within the spectral range corresponding to each peak. The two methods are perfectly equivalent both in precision and accuracy. For the estimation of the uranium/thorium ratios, precisions were obtained which agree with the dispersions in the measurements of the absolute contents in uranium and thorium. The evaluation of such ratios by means of the heights of the peaks leads to exceedingly poor accuracies and precisions. The contribution of each actual source of error to the total variance is emphasized. (auth)

General Inorganic and Physical Chemistry

2609 (AERE-R-3262) ON THE POSSIBILITY OF RADIATION INDUCED TRANSPORT OF CARBON IN HELIUM. I. N. Onslow MacAulay and M. Tomlinson. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Jan. 1960. 17p. BIS.

Pyrolytic-carbon films were exposed to the plasma generated by microwave radiation in a stream of helium at 6-mm pressure. The film disappeared at a rate which decreased as the helium purity was improved. The same effect was obtained by heating to 1100°C without the microwaves. No carbon transport was detected which could not be ascribed to attack by impurities in the helium. From these observations, and from theoretical considerations, it is inferred that there is no reaction between ionized or excited helium and carbon which is sufficient to cause significant attack on the graphite in a helium-cooled graphite-moderated reactor. (auth)

2610 (AFCRC-TR-60-139) A METHOD FOR MEASUREMENT OF THE HEAT OF FORMATION OF SILICON CARBIDE. Final Report [for] Period May 15, 1959 to April 30, 1960. J. W. Droege and J. F. Foster. Battelle Memorial Inst., Columbus, Ohio. Apr. 30, 1960. 21p. Contract AF19(604)-5720. (AD-237662).

Sodium peroxide calorimetry was investigated as a method for the determination of the heat of formation of SiC. Zirconium was found to be a suitable container material; corrosion losses amounted to no more than a few milligrams in each experiment. Reaction with the fuels SiC, silicon, and carbon was not complete, but the reaction product could be analyzed for unreacted sample. Benzoic acid was used as a combustion aid and oxygen at 5 atm as an oxidation promoter. The method seems well suited to the SiC determination. (auth)

2611 (ANL-6238) A DESCRIPTION OF THERMAL CONDUCTIVITY AND DYNAMIC VISCOSITY OF WATER IN THE CRITICAL REGION. C. A. Fritsch and R. J. Grosh. Purdue Research Foundation, Lafayette, Ind. Oct. 1960. 44p. For Argonne National Lab. Contract W-31-109-eng-38, Subcontract 31-109-38-704. OTS.

A study to establish reasonable estimates of the values of thermal conductivity and dynamic viscosity of water in the critical region was conducted. This was accomplished by reviewing the literature and utilizing available experimental measurements. The validity of the estimates was strengthened by the use of the principle of corresponding states after other considerations failed to contribute a description of these two transport properties in the critical region. The final results were expressions of a thermal conductivity excess and dynamic viscosity excess as unique functions of density. (auth)

2612 (CF-60-7-26) OXIDATION OF HYDROGEN AND CARBON MONOXIDE IN HELIUM BY USE OF CuO. I. PRELIMINARY RESULTS. C. D. Scott. Oak Ridge National Lab., Tenn. July 18, 1960. 21p. OTS.

Reagent grade CuO wire was shown to be an excellent oxidizing agent for hydrogen and carbon monoxide in a flowing stream of helium. Design equations for fixed-bed CuO oxidizers were developed for helium contaminated with hydrogen and carbon monoxide in the range 0.66 to 3.50% at a total pressure of 300 psia, bed temperatures of 388 to 573°C, and mass flow rates of 0.029 to 0.167 gram-moles/cm²/min. It is proposed that depletion of the CuO bed and regeneration by use of air at 400 and 500°C decreases the bed capacity due to bed sintering and gas channeling. (auth)

2613 (GA-1385) CHEMISTRY OF URANIUM–OXYGEN SYSTEMS. First Quarterly Report for the Period January 1, 1960–March 31, 1960. J. T. Porter. General Atomic Div., General Dynamics Corp., San Diego, Calif. Apr. 15, 1960. 7p. Project No. 74. Contract AT(04-3)-167. OTS.

Experimental work was concentrated on an exploration of the 1100°C isothermal section of the Nb–U–O system by use of x-ray diffraction. The Nb–U–O system shows complexity. The data obtained so far for oxygen content less than MO_2 can be interpreted in terms of known compounds plus Nb_4O. For the composition MO_2, there appears to be neither solid solution formation nor compound forma-

tion. Compositions richer in oxygen than MO_2 show solid solution with structures isomorphous with normally metastable forms of Nb_2O_5 and/or uranium oxides and the formation of compounds. In view of the complexity, particularly for oxygen content greater than MO_2, diffraction studies are continuing to delineate the phase regions. (W.L.H.)

2614 (KAPL-2000-11(p.I.3-I.11)) VOLTAMMETRY WITH A MERCURY POOL CATHODE. D. P. Stricos. Knolls Atomic Power Lab., Schenectady, N. Y.

A detailed description is given of the polarographic cell and assembled apparatus. Results of a series of experiments to determine the precision of the apparatus are presented. (W.L.H.)

2615 (KAPL-2000-11(p.II.12-II.13)) THE NATURAL ABUNDANCE OF B^{10} IN BORON. T. L. Collins, Jr. Knolls Atomic Power Lab., Schenectady, N. Y.

Until recently, the most widely accepted value for the abundance of B^{10} in natural boron was 18.8 at. % (17.4 wt. %). A series of measurements on the Argonne-Brookhaven Standard boron sample led to a value of 19.80 ± 0.25 at. % B^{10} in this sample. Additional work on the Standard leads to a value of 19.80 ± 0.12 at. % B^{10} at the 95% confidence level. As a result of investigations, it is concluded that B^{10} abundance in natural boron is 19.80 ± 0.12 at. % (18.34 wt. %). (W.L.H.)

2616 (NP-9270) TECHNICAL REPORTS NO. 28 AND 29. 28. THE VAPOUR PRESSURES OF SOME HEAVY TRANSITION METAL HEXAFLUORIDES. 29. VAPOUR PRESSURES OF SOME FLUORIDES AND OXYFLUORIDES OF MOLYBDENUM, TUNGSTEN, RHENIUM AND OSMIUM. George B. Hargreaves and George H. Cady. Washington. Univ., Seattle. 1960. 37p. Project NR 093-348. Contract Nonr-477(16).

The vapor pressures of the hexafluorides of tungsten, molybdenum, rhenium, osmium, and iridium were measured by a static method using a diaphragm gage of high sensitivity. Hitherto-unknown solid-solid transitions are reported for rhenium, osmium, and iridium hexafluorides together with those known for tungsten and molybdenum hexafluorides. These are respectively: −1.9°, −0.4°, +0.4°, −8.2°, and −8.7°. From the vapor-pressure data more accurate physical constants, latent heats of vaporization and sublimation, heats of fusion and transition, and entropies of fusion, transition and vaporization were calculated. Nuclear magnetic resonance studies with both solid and liquid hexafluorides suggest that there is molecular rotation in the solid state above the transition point. The vapor pressures of the pentafluorides ReF_5, MoF_5, OsF_5; the oxytetrafluorides $ReOF_4$, $MoOF_4$, WOF_4; and the oxyfluorides $ReOF_5$ and ReO_2F_3 were measured by a static method using a diaphragm gage of high sensitivity. The physical constants, heats of sublimation and vaporization, and entropies of vaporization were derived from the vapor-pressure data. The oxypentafluoride $ReOF_5$ was studied in detail and a hitherto-unknown solid-solid transition at 30.0° is reported. The thermal disproportionation of the pentafluorides is described. (auth)

2617 (NP-9421) INFLUENCE OF MAGNETIC INTERACTION ON THE NUCLEAR ORIENTATION OF COBALT-60 IN RARE EARTH DOUBLE NITRATES. Technical Report No. 1. M. W. Levi, R. C. Sapp, and J. W. Culvahouse. Kansas. Univ., Lawrence. Nov. 1, 1960. 42p. Contract Nonr-2775(00).

The effect of ionic spin-spin interactions on nuclear orientation of Co^{60} in cerous zinc nitrate was investigated in single-crystal spherical samples cooled below 1°K by adiabatic demagnetization. An experimental demonstration is given that Ce–Co interaction is the cause of the apparently anomalous alignment data. By hypothesizing the existence of a temperature-dependent internal magnetic field, exerted on cobalt ions by spatially ordered cerium dipoles below the critical temperature, a simple but quantitatively satisfying description of the observed phenomena was obtained in the molecular field approximation with $T_c = 6.9 \pm 0.1°K$ and $H_0 = 165 \pm 20$ oersteds. The nature of the ordered state could not be inferred in detail, however. In the theoretical calculations, measured values of g-factors and hfs splittings of cobalt ions in the cerium salt were used where appropriate. Crystal-structure information is invoked only for the purpose of a symmetry argument. Finally, the effectiveness of Ce–Zn nitrate as a paramagnetic medium for nuclear-orientation experiments is pointed out. (auth)

2618 (NP-9422) MAGNETIC INTERACTIONS OF CERIUM AND COBALT IONS IN DOUBLE NITRATE CRYSTALS. Technical Report No. 2. J. W. Culvahouse, W. Unruh, and R. C. Sapp. Kansas. Univ., Lawrence. Nov. 1, 1960. 41p. Contract Nonr-2775(00).

The space group of the double nitrate crystals $M_2^{3}M_3^{2}(NO_3)_{12} \cdot 24H_2O$ where M′ is a trivalent cation and M″ is a divalent cation has been determined from x-ray data to be $R\bar{3}m$. The rhombohedral unit cell has sides of 13.9 A and interaxial angles of 49°, and it contains one molecule. The cerium ions have the location ±(¼, ¼, ¼). The line shapes of the derivative of paramagnetic-resonance absorption of small concentrations of cobaltous ions substituted in $Ce_2Zn_3(NO_3)_{12} \cdot 24H_2O$ are described and used to determine the spatial relations of the cerium ions and cobalt ions, as well as to justify the assumption of a dipolar interaction between them described by the spin Hamiltonian parameters of the cerium and cobalt ions. It is concluded that the more isotropic of the two paramagnetic spectra of cobalt ions observed in this salt is due to ions in either the special sites ±(0.399, 0.399, 0.399) or, less likely, in the special sites ±(0.101, 0.101, 0.101) and that the highly anisotropic spectra of cobalt ions is due to ions in the body-centered site. (auth)

2619 (SCTM-256-60(14)) VAPOR PRESSURES OF THE RARE EARTHS. L. C. Beavis. Sandia Corp., Albuquerque, N. Mex. Aug. 2, 1960. 14p. OTS.

Vapor pressure vs. temperature data are presented graphically for yttrium and scandium. (auth)

2620 (TID-6637) THE RELATIONSHIP BETWEEN OXIDE FILMS AND ELECTRODE POTENTIALS. Annual Progress Report for January 1, 1960 to August 26, 1960. Robert C. Plumb. Worcester Polytechnic Inst., Mass. Oct. 4, 1960. 7p. Contract AT(30-1)-2479. OTS.

An apparatus was designed to measure the dependence of the electrode potential of an electrode upon the degree of oxidation. An apparatus was designed and constructed for measuring the oxidation of initially oxide-free metal surfaces at room temperatures. Procedures were developed for measuring the optical constants of aluminum-metal films during formation in vacuum. The effect of nonstoichiometry on the chemical potential of an ion was examined. Equations were derived for transients in potential when dissimilar phases are brought into contact. (C.J.G.)

2621 (TID-6885) THE EFFECT OF CERTAIN VARIABLES ON THE POLARIZATION CAPACITY OF ZIRCONIUM. Technical Report No. XXXIII. A. B. Johnson, Tennyson Smith, and George Richard Hill. Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

Oct. 15, 1960. 22p. Project No. 1. Contract AT(11-1)-82. OTS.

The polarization capacity of zirconium was measured, using the Wagner ballistic-galvanometer method. Variables investigated included potential, electrolyte concentration, temperature, surface area, and surface treatment. The capacity at the potential minimum was 2.5 ± 0.2 μf/cm². Changes in capacity with time after etching or abrading were interpreted in terms of oxide film growth. (auth)

2622 (UCRL-9330) INFRARED SPECTRA OF MARGINALLY METALLIC SYSTEMS. (thesis). Tad Alan Beckman. California. Univ., Berkeley. Lawrence Radiation Lab. Aug. 1960. 70p. Contract W-7405-eng-48. OTS.

Solutions of sodium metal in liquid ammonia have been studied with particular reference to their properties as marginally metallic systems. For this purpose, a general method of reflection spectroscopy has been developed. This method is of particular usefulness for the infrared-reflection study of liquids. Sodium–ammonia solutions were prepared inside a specially constructed reflection apparatus maintained at –40°C. The plane surface formed by a given solution and a transparent material, or window, sealed to the side of this apparatus was used as the reflection plane. The spectra obtained were interpreted in terms of the standard reflection of a mercury surface under identical conditions. Predictions of the reflection spectra are made on the basis of classical theories of metallic reflection. Comparison of the observed spectra with these predictions discloses marked deviations from the purely classical form of metallic behavior. These deviations are given an interpretation in terms of the continuous transition of electronic states between those of a perturbed atom and those of sodium metal. (auth)

2623 (USNRDL-TR-471) TRITIUM β RADIATION-INDUCED ISOTOPIC EXCHANGE IN THE T_2–H_2O SYSTEM. J. Y. Yang and L. H. Gevantman. Naval Radiological Defense Lab., San Francisco. Sept. 28, 1960. 21p.

The conversion of H_2 to tritiated water through its β-radiation-induced isotopic exchange with water vapor was investigated. It was found that under simulated normal atmospheric conditions with H^3 concentration in the range of 0.05 to 0.7 curies/liter, the rate of conversion of H^3 to tritiated water is independent of the water vapor density. On the other hand, a second-order dependency on the initial H^3 concentration was observed. The isotopic exchange rate, R, expressed in mc/liter/day may be approximated by the following equation: $R = 4 \times 10^{-3} [T_{2_0}]$ where $[T_{2_0}]$ is the initial tritium concentration in mc/liter. Results from x irradiation of the reaction mixture indicate that the exchange rate is essentially proportional to radiation absorption. Lowering of the reaction rate by dilution of H^3 with protium was observed. The presence of a number of moderating gases was found to exert a small but apparently significant effect on the reaction rate. To account for the marked inhibiting effect of nitric oxide, a reaction mechanism involving radical intermediates is proposed. (auth)

2624 (WAPD-T-401) A COMPILATION OF THE BASIC PHYSICAL PROPERTIES OF LIGHT WATER. Benjamin N. Nelson. Westinghouse Electric Corp. Bettis Plant, Pittsburgh. Aug. 7, 1956. 44p. OTS.

References concerning the basic physical properties of light water are reviewed, and data are tabulated. (J.R.D.)

2625 (AEC-tr-4289) SOME RULES FOR PLOTTING PHASE DIAGRAMS OF BINARY SYSTEMS. S. D. Gromakov and L. M. Gromakova. Translated by Lydia Venters (Argonne National Lab.) from Zhur. Fiz. Khim. 27, 1545-55 (1953). 15p. JCL.

The significance of previously established rules for plotting phase diagrams for binary systems is outlined. Using these rules, the experimental testing of 10 systems was carried out. Results are included. (J.R.D.)

2626 (AEC-tr-4299) HEAT OF ADSORPTION IN THE ELECTRONIC CHEMICAL SORPTION THEORY. Sh. M. Kogan and V. B. Sandomirskiĭ. Translated by Lydia Venters (Argonne National Lab.) from Zhur. Fiz. Khim. 33, 1129-33(1959). 8p. JCL or LC.

The electronic chemical sorption theory is examined, and the dependence of heat of adsorption on semiconductor surface potentials is discussed. A calculation scheme for determining the differential heat of adsorption on surface filling, within the electronic theory of chemisorption framework, is included along with conclusions. (J.R.D.)

2627 (NP-tr-513) SYNTHESIS OF HIGHER FLUORIDES OF NIOBIUM, TANTALUM AND MOLYBDENUM WITH THE AID OF CHLORINE TRIFLUORIDE. (Sintez Vysshikh Ftoridov Niobiya, Tantala i Molibdena pri Pomoshchi Trekh-ftoristogo Khlora). N. S. Nikolaev (Nikolayev), Yu. A. Buslaev (Buslayev), and A. A. Opalovskiĭ (Opalovskiy). Translated from Zhur. Neorg. Khim. 3, 1731-3(1958). 6p.

French translation available as CEA-tr-R-634.

This paper was previously abstracted from a French translation and appears in NSA, Vol. 13, abstract No. 12484.

2628 (SCL-T-338) INVESTIGATION OF THE REACTIONS OF ALKALI CHLORIDES AND OF ALKALINE EARTH ELEMENTS IN MELTS. IV. TERNARY SYSTEM CONSISTING OF LITHIUM CHLORIDES, POTASSIUM AND CALCIUM. (Issledovanie Vzaimodeistviya Khloridov Shchelochnykh i Shchelochnozemel'nykh Elementov v Rasplavakh. IV. Troinaya Sistema iz Khloridov Litia, Kalia i Kal'tsia). V. E. Plyushchev and F. V. Kovolev. Translated by Marcel I. Weinreich (Sandia Corp.) from Zhur. Neorg. Khim. 1, 1013-18(1956). 14p. JCL or LC.

The interaction between the chlorides of lithium, potassium, and calcium in melts was investigated by the visual-polythermal method. The isotherms were constructed on the surface of the liquidus of the $LiCl–KCl–CaCl_2$ system. The existence was established, in the system, of four areas of primary crystallization: LiCl, KCl, $CaCl_2$, and the double compound $KCl \cdot CaCl_2$. Two ternary eutectics crystallize at 425°C (E_1) and at 340°C (E_2); they have their correspondence in the following compositions: E_1–LiCl–54.4 M %, KCl–14.5 M %, and $CaCl_2$–31 M %; E_2–LiCl–50.9 M %, KCl–43.3 M %, and $CaCl_2$–5.8 M %. (W.L.H.)

2629 SOLUBILITY PRODUCT OF THE HYDROXIDE OF U(IV). M. A. Stepanov and N. P. Galkin. Atomnaya Energ. 9, 282-5(1960) Oct. (In Russian)

The solubility product of $U(OH)_4$ is evaluated on the basis of data from the potentiometric titration of U(IV) with alkali. The tube potentiometer αp-5 was used for determining hydrogen ion activity and the active concentration of U(IV) was determined analytically with considerations for hydrolysis and the magnitude of the ion force. The solubility product is $(1.10 \pm 0.72) \times 10^{-52}$. (R.V.J.)

2630 STUDY OF ZIRCONIUM FIXATION BY ACID MONTMORILLONITE ACID. R. Bittel, C. Boursat, and R. Platzer (Centre d'Etudes Nucléaires, Saclay, France). Bull. groupe franç. argiles [N. S.] 11, 9-19(1959). (In French)

In connection with work on the use of clays as ion ex-

changes for atomic energy problems, the behavior of montmorillonite acid in the presence of acid solutions of zirconium salts was studied. Comparing the results with those obtained elsewhere for salts of other elements (alkalis, alkaline earths, and uranium), anomalies were observed with regard to the fixation capacity (2.4 meq ZrO^{2+}/g of clay while the exchange capacity for the other ions is close to 1 meq/g). The most probable explanation is that zirconium is fixed on clay in the form of very condensed ions. The observation of this phenomenon can help to provide a better understanding of the complexity of the fixation mechanism and of the chemistry of zirconium in general. (auth)

2631 SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATIONS. III. COPRECIPITATION OF STRONTIUM AND YTTRIUM WITH POLYURANATE PRECIPITATIONS. Z. Kolařík and V. Kouřím (Czechoslovak Academy of Sciences, Prague). Collection Czechoslov. Chem. Communs. 25, 2440-8(1960) Sept. (In German)

The coprecipitation of various masses of strontium with polyuranates was investigated radiometrically as a function of the hydrogen, strontium, ammonium, sodium, and potassium ion concentrations. Simultaneously, the dependence of the coprecipitation of yttrium traces on the hydrogen ion concentration was followed. Strontium was carried down in the polyuranate precipitate in the form of strontium polyuranate; its composition under various conditions was determined. (tr-auth)

2632 INFLUENCE OF LOW WATER-VAPOR CONCENTRATIONS IN AIR AND CARBON DIOXIDE ON THE INFLAMMABILITY OF MAGNESIUM IN THESE MEDIA. Raymond Darras, Pierre Baque, and Daniel Leclercq (Commissariat à l'Énergie Atomique, Saclay, France). Compt. rend. 249, 1647-9(1959) Oct. 28. (CEA-1372)

The temperatures at which live combustion starts in magnesium and certain of its alloys were determined systematically in air and in carbon dioxide. In carbon dioxide, the ignition temperature is reduced by 130 to 140°C for very low water-vapor concentrations. (auth)

2633 ON A NEW METHOD FOR THE PREPARATION OF NON-STOICHIOMETRIC COLORED ALUMINA. Basile Argchiropoulos, Jean Elston, François Juillet, and Stanislas Teichner. Compt. rend. 249, 2549-51(1959) Dec. 9. (In French). (CEA-1452)

An alumina (variety δ) in the form of nonporous spherules of diameter 150 A can be colored black by treatment under vacuum (10^{-6} mm mercury) at 500°C, if it is previously compressed under a pressure of 1 to 3 tons/cm^2. This coloration is linked with the loss of oxygen. The nonstoichiometry of the black alumina is shown on the McBain balance and by electrical conductivity measurements. (auth)

2634 THE COMPOUNDS $NaF \cdot BeF_2 \cdot 3ThF_4$ AND $NaF \cdot BeF_2 \cdot 3UF_4$. R. E. Thoma, C. F. Weaver, H. A. Friedman, and L. A. Harris (Oak Ridge National Lab., Tenn.). J. Am. Ceram. Soc. 43, 608-9(1960) Nov.

Several equilibrated samples of $NaF-BeF_2-ThF_4$ and $NaF-BeF_2-UF_4$ at or near the ternary compound compositions were quenched to test the speculation that the $NaF \cdot 4UF_4$ phase in $NaF-UF_4$ mixtures reported by Eichelberger et al. was actually $NaF \cdot BeF_2 \cdot 3UF_4$. Results from studies of melting temperature, optical properties, and x-ray-diffraction patterns indicated that the material designated $NaF \cdot 4UF_4$ was actually $NaF \cdot BeF_2 \cdot 3UF_4$. (M.C.G.)

2635 KINETICS OF THE REDUCTION OF NEPTUNIUM(VI) BY URANIUM(IV). J. C. Sullivan, A. J. Zielen, and J. C. Hindman (Argonne National Lab., Ill.). J. Am. Chem. Soc. 82, 5288-92(1960) Oct. 20.

The kinetics of the reaction 2 neptunium(VI) + uranium(IV) = 2 neptunium(V) + uranium(VI) were studied in aqueous perchloric acid solutions and found to follow the rate law: $d[NpO_2^+]/dt = 2\,k[U^{4+}]\,[NpO_2^+]/[H^+]$. At an ionic strength of 2.00 and 25° the thermodynamic quantities of activation for the complex $(UOH \cdot NpO_2)^{5+}$ were found to be: $\Delta F^* = 16.05 \pm 0.01$ kcal/mole, $\Delta H^* = 18.2 \pm 0.2$ kcal/mole, and $\Delta S^* = 7.4 \pm 0.8$ eu. The effect of deuterium, ionic strength, and the charge of the cations used to maintain the ionic strength were determined. The kinetics of analogous reactions of the (IV) and (VI) states of uranium, neptunium, and plutonium are discussed. (auth)

2636 SEPARATION OF PARAHYDROGEN, ORTHOHYDROGEN, HYDROGEN DEUTERIDE, ORTHODEUTERIUM AND PARADEUTERIUM BY GAS ADSORPTION CHROMATOGRAPHY. Takao Kwan (Hokkaido Univ., Sapporo). J. Research Inst. Catalysis, Hokkaido Univ. 8, 18-28(1960) July. (In English)

Gas chromatographic separation of HD, ortho-D_2, and para-D_2 was demonstrated at liquid nitrogen temperatures by using a Linde molecular sieve as the column packing and hydrogen as the carrier gas. Separation of para-H_2 and ortho-H_2 also was achieved by a similar technique that used helium as the carrier gas. Isolation and analysis of these hydrogen isotopes and isomers by gas-adsorption chromatography were reviewed and discussed. (auth)

2637 THE EFFECT OF SOME HYDRODYNAMIC FACTORS ON THE CATALYTIC DEUTERIUM EXCHANGE REACTION BETWEEN HYDROGEN AND WATER VAPOUR. Anatol Selecki (Univ. of Warsaw). Nukleonika 5, 513-30 (1960). (In Polish)

The results of investigations of the effect of some hydrodynamic factors on the kinetics of the deuterium exchange catalytic reaction between hydrogen and water vapor at relatively low deuterium concentration are given. The effect of the linear velocity of reactants, size of catalyst grains, and the height of catalyst bed was investigated. A nickel–chromium oxide catalyst was used. The results indicated that the reaction rate constantly increased with a decrease in the size of catalyst grains and with a rise of linear velocity of the reactants, but an analysis of the hydrodynamic conditions showed that the mass transfer from gas stream to the catalyst surface expressed in terms of HTU/HRU was very small. The determination of activation energy gave a high value of ca 12 kcal/mole. The conclusion was drawn that the reaction takes place in internal diffusion kinetic zone. The dependence of reaction rate constant on the linear velocity of reactants was interpretated by the influence of the hold back. (auth)

2638 PREPARATION OF CALCIUM OF HIGH PURITY. Marian Orman and Adam Galanty (Inst. of Non-Ferrous Metals, Skawina, Poland). Nukleonika 5, 551-8(1960). (In Polish)

The preparation of very pure calcium is described. Technical pure calcium was used as raw material. By distillation and fractionized condensation of the raw material, calcium of high purity was obtained. (auth)

2639 NUCLEAR QUADRUPOLE RESONANCE IN SUPERCONDUCTING GALLIUM. R. H. Hammond and W. D. Knight (Univ. of California, Berkeley). Phys. Rev. 120, 762-72(1960) Nov. 1.

The nuclear quadrupole resonance (NQR) of Ga^{69} is investigated between 0.8 and 4.2°K. (The superconducting

critical temperature is 1.084°K.) Progressive saturation of the resonance is produced at increasing radio-frequency (r-f) power levels of a frequency-modulated marginal oscillator. The nuclear spin-lattice relaxation rate $1/T_1$ (sec^{-1}) is approximately $\frac{1}{2}T$ (°K) in the normal state. The contact part of the hyperfine interaction appears to be predominant in producing relaxation. Although the saturation method does not permit a precise determination of the constant of proportionality, the comparison of normal and superconducting relaxation rates is considerably more reliable. The r-f fields are assumed to obey the London law of penetration, and an average r-f field is determined in the superconductor. The relaxation rate shows a maximum enhancement by a factor 1.8 at ~0.95 T_c, a result which agrees with that obtained by Slichter and Hebel, and Redfield for the nuclear magnetic resonance of aluminum, and which serves as an additional experimental justification for certain features of the Bardeen-Cooper-Schrieffer theory of superconductivity. Unsaturated signal intensities in normal and superconducting states furnish a basis for estimating the penetration depth in superconducting metal spheres: $\lambda(0) = 1200$ A for an average particle diameter of 2.7 μ. The NQR frequency of gallium in the superconductor shifts by (+) 5×10^{-5} of the normal frequency [the corresponding result for indium is found to be ~(–) 10^{-2}]. This means that the contribution of the conduction electrons to the average nuclear quadrupole coupling is modified by the rearrangement of the conduction band in the superconductor. It is demonstrated that if the quadrupole term in the hyperfine interaction were to predominate the spin relaxation rate in the superconductor would have a temperature dependence like that of the ultrasonic attenuation. (auth)

2640 ELECTRON PARAMAGNETIC RESONANCE OF EUROPIUM(II) IN SINGLE CRYSTALS OF CADMIUM SULFIDE. Paul B. Dorain (Brandeis Univ., Waltham, Mass.). Phys. Rev. 120, 1190-2(1960) Nov. 15.

Paramagnetic resonance absorption measurements were made with single crystals of cadmium sulfide containing europium(II). The results can be fitted to the usual spin-Hamiltonian for ^8S state. The zero field splitting is about 0.4 cm^{-1}. A comparison of the results with present theorie for the crystal field splittings of ^8S is made. (auth)

2641 SOLUBILITY OF DOUBLE SULFATES OF CERIUM AND LANTHANUM IN SATURATED SULFATE SOLUTIONS BY MEANS OF RADIOACTIVE TRACERS. V. N. Bobrova. Radiokhimiya 2, 500-4(1960). (In Russian)

Double sulfates of potassium and lanthanum, potassium and cerium [the composition $K_5La(SO_4)_4$ and $K_5Ce(SO_4)_4$] were synthesized, and their solubility in saturated potassium sulfate solutions in 0.5 N and 1.5 N HNO_3 was determined. It was found that the solubility of the double sulfates depends on the concentration of the nitric acid in the solution. (R.V.J.)

2642 ON THE INSTABILITY CONSTANTS OF URANIUM OXALATE COMPLEXES. A. A. Grinberg, G. I. Petrzhak, and L. I. Evteev. Radiokhimiya 2, 505-6(1960). (In Russian)

A general instability constant $\sim 10^{-38}$ was found for the process $[U(C_2O_4)_4]^{4-} \rightleftharpoons U^{4+} + 4C_2O_4^{2-}$ by potentiometric titration of $K_4[U(C_2O_4)_4] \cdot 5H_2O$ with alkali until it formed uranium hydroxide. (R.V.J.)

2643 CRYSTALLOGRAPHIC CHARACTERISTICS OF THE CUBIC AND ORTHORHOMBIC FORMS OF THORIUM PYROPHOSPHATE. Aurelio Burdese and Maria Lucco Borlera (Istituto di Chimica Generale e Applicata e di Metallurgia del Politecnico, Turin). Ricerca sci. 30, 1343-5(1960) Sept. (In Italian)

The compound α-ThP_2O_7 is cubic ($a_0 = 8.72$ A); the β form is orthorhombic with the lattice constants $a_0 = 11.61$ A, $b_0 = 12.75$ A, and $c_0 = 7.12$ A. (auth)

2644 THE ISOTOPIC EFFECT IN THE VISCOSITY OF DEUTEROGLYCERINE AND ETHYLENEDEUTEROGLYCOL. I. B. Rabinovich, V. I. Murzin, and L. S. Zhilkin (Gorkiĭ State Univ.). Zhur. Fiz. Khim. 34, 1973-5(1960) Sept. (In Russian)

A study was made of the viscosity of glycerine and ethyleneglycol in which the hydroxyl hydrogen was replaced by deuterium in comparison with the viscosity of the ordinary compounds. Determinations were made in the temperature range 20 to 90°C. The value of η_D/η_H is 1.165 to 1.090 for glycerine and 1.09 to 1.02 for ethyleneglycol. The large values for the isotopic effect are explained by its exponential dependence upon the isotopic difference in activation energy of viscous flow, which in turn is exponentially related to the isotopic difference in zero energy of vibrations that correspond to the hydrogen bond. (auth)

2645 SURFACE TENSION OF MOLTEN SALTS. I. TECHNIQUE OF MEASUREMENT. I. D. Sokolova and V. A. Sokolov (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim. 34, 1987-90 (1960) Sept. (In Russian)

An arrangement is described for determining the surface tension of molten salts up to temperatures of the order of 1200° based on the maximum-bubble-pressure method. For measuring pressures in the range 3 to 5 mm Hg a syphon gage devised especially for this purpose was employed. The values for the surface tension of molten sodium chloride are in good agreement with the most reliable of those reported in the literature. (auth)

2646 NOUVEAU TRAITÉ DE CHIMIE MINÉRALE. TOME VII. (New Treatise on Inorganic Chemistry. Volume 7). Paris, Masson et Cie, 1959. p.707-1473.

Part two is presented of a comprehensive review of the chemistry of rare earths and actinium. The chapters in the rare earth section deal with chemical properties of the metals, compounds with metalloids (H_2 and D_2), compounds with group VII metalloids (F, Cl, Br, I), compounds with group VI metalloids (O_2, S, Se, Te), compounds with metalloids of group V (N, P, As, Sb), compounds with metalloids of group IV (C, S, CN), compounds with metalloids of group III (B), salts derived from oxygen-containing anions, organic compounds, alloys, nuclear properties and applications, promethium, study and determination of rare earths, and applications and uses. The actinium section has chapters on isotopic and nuclear properties, preparation, electrolytic deposition, physical properties, chemical properties, physiological properties, analytical data, atomic weight, and actinium compounds. Each chapter has bibliographic references, and the volume has a subject index. (T.R.H.)

Radiation Chemistry and Radiochemistry

2647 (HW-SA-1748) HANFORD'S NEW HIGH-LEVEL RADIOCHEMISTRY FACILITY. K. H. Hammill and J. E. Brown. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Dec. 17, 1959. 18p. OTS.

Design features are described for a radiochemistry laboratory specifically designed for experimentation with highly radioactive solutions of relatively large volume. The facility will be used for the evaluation of reprocessing

methods developed in the study of plutonium-fuel recycle technology, atomic-waste-processing studies, and investigations into the possibilities of isotope recovery from atomic wastes. Special equipment is illustrated photographically. (C.H.)

2648 (NYO-9481) FISSION PRODUCT APPLICATIONS USING GASEOUS BETA SOURCES. Quarterly Progress Report No. 5 Covering Period: July 1, 1960 to September 30, 1960. William W. Graessley and John H. Zufall. Air Reduction Co., Inc. Central Research Labs., Murray Hill, N. J. 16p. Contract AT(30-1)-2343. OTS.

Rates of acetylene polymerization induced by Kr^{85} in d-c fields were up to 15 times greater than those observed when no fields were imposed. Work to determine the relations between acetylene pressure, Kr^{85} concentration, and the field intensity is continuing. In other activities, equipment is being designed to study the effects of megacycle electric fields on radioinduced chemical reactions. (For preceding period see NYO-2606.) (J.R.D.)

2649 (PA-TR-2673) EFFECTS OF X-RAY AND GAMMA RAY IRRADIATION ON THERMAL DECOMPOSITION OF SOLID AMMONIUM PERCHLORATE. Eli S. Freeman and David A. Anderson. Picatinny Arsenal. Feltman Research and Engineering Labs., Dover, N. J. Apr. 1960. 28p. DA Project No. 5804-01-027.

The effects of x and γ radiation on the thermal decomposition of ammonium perchlorate and the relations between radiation damage, defect structure, and chemical reactivity were investigated. It was found that high-energy radiation significantly alters the physicochemical properties of ammonium perchlorate. Specifically, the irradiation of ammonium perchlorate by x and γ radiation appreciably enhances its low-temperature thermal decomposition. The presence of impurities, which may act as a bridge in the electron-transfer process, also catalyzes the low-temperature stages of decomposition (below 380°C). (auth)

2650 (CEA-tr-A-622) MARQUAGE ISOTOPIQUE DE COMPOSÉS ORGANIQUES PAR IRRADIATION NEUTRONIQUE. (Isotopic Labelling of Organic Compounds by Neutron Irradiation). A. P. Wolf. Translated into French from Angew. Chem. 71, 237-43(1959). 34p.

The theory behind neutron-labeling of organic compounds is presented and the nature of the labeled products is discussed. Specific procedures are reviewed for C^{14}, H^3, and other isotopes. The technique is said to be useful where large quantities of labeled product with a low specific activity are needed. The material to be labeled must be pure and the location of the radioisotope in the molecule must not be critical. (T.R.H.)

2651 (CEA-tr-R-933) ACTION CHIMIQUE DES ATOMES OBTENUS À LA SUITE DE TRANSFORMATIONS NUCLÉAIRES. (Chemical Effects of Atoms from Nuclear Reactions). A. N. Nesmeyanov (Nesmeianov) and E. A. Borisov (Borissov). Translated into French by B. Sakharoff from Uspekhi Khim. 27, 133-61(1958). 95p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract No. 9059.

2652 (CEA-tr-X-233) MÉTHODE DE SÉPARATION DE L'IODE 131 A PARTIR DU PRODUIT DE BOMBARDEMENT DU TELLURE PAR LES NEUTRONS. (Method of Separation of I^{131} from the Products of Neutron Bombardment of Tellurium). M. Inada. Translated into French from Nippon Kagaku Zasshi 80, 400-1(1959). 9p.

The radioisotope I^{131} is produced by neutron bombardment of tellurium. The tellurium thus contains radioisotopes of tellurium and I^{131} from β decay of Te^{131}. The I^{131} cannot be used unless it is separated. Methods of separation are described which involve ion exchange and precipitation as sulfurous anhydride. The experimental results show that the yield reaches 50 to 60% for ion exchange and about 30% for precipitation. (T.R.H.)

2653 ADDITION REACTIONS INITIATED UNDER RADIATION; ADDITION OF CARBON TETRABROMIDE TO OLEFINS. Guy Rabilloud and Philippe Traynard (Centre d'Etudes Nucléaires, Grenoble, France). Compt. rend. 251, 1505-6(1960) Oct. 10. (In French)

The irradiation of a diluted solution of olefin in a mixture of CCl_4 and CBr_4 leads to the addition of carbon tetrabromide on the double bond. As the velocity of the addition is a function of the alkene structure, an attempt was made to compare the affinity of some olefins with respect to the free radicals created in the solvent. For this study twelve original compounds were prepared. (tr-auth)

2654 THE REACTIONS OF RECOIL TRITIUM ATOMS WITH UNSATURATED ACIDS. R. Milford White and F. S. Rowland (Univ. of Kansas, Lawrence). J. Am. Chem. Soc. 82, 5345-9(1960) Oct. 20.

Recoil H^3 atoms substitute into all of the hydrogen positions of crystalline cis- and trans-cinnamic acid and of sodium trans-cinnamate. The specific activities of the different positions of the aromatic ring are within 25% of each other for the trans compounds (and benzoic acid), and decrease in the order ortho > para > meta. The specific activity of the o-position in cis-cinnamic acid is about half that of the m- and p-positions, perhaps because of steric interference by the –COOH group. Replacement of nonlabile hydrogen by recoil H^3 in maleic and fumaric acids is accompanied by geometric cis–trans isomerization in <5% of the substitutions. Addition to the double bond to form succinic acid is about half as frequent as substitution for hydrogen in the parent molecule. Addition to the triple bond of phenylpropiolic acid leads to labeled cinnamic acid, more than 90% in the trans form. The substitution of H^3 for hydrogen is explained in terms of high kinetic energy reactions involving a minimum of atomic motion during substitution. (auth)

2655 GROWTH AND DECAY OF RADIONUCLIDES. A DEMONSTRATION. R. L. Hayes and W. R. Butler, Jr. (Inst. of Nuclear Studies, Inc., Oak Ridge, Tenn.). J. Chem. Educ. 37, 590-2(1960) Nov.

A simple and rapid laboratory method for the separation of Ba^{137m} from Cs^{137} was developed. The technique may be used for laboratory exercises or for lecture demonstrations to show radionuclide growth to secular equilibrium as well as radionuclide decay. Since the half life of Ba^{137m} ($t_{\frac{1}{2}}$ = 2.63 min) is conveniently short, both processes can be easily demonstrated in one laboratory or lecture period. (auth)

2656 STUDY BY ELECTRON PARAMAGNETIC RESONANCE OF THE RADICALS FORMED IN CYCLOHEXANE BY IRRADIATION AT 77°K. H. Szwarc and R. Marx. J. chim. phys. 57, 680(1960) Sept. (In French)

Cyclohexane at the temperature of liquid nitrogen was irradiated under vacuum with x and γ rays. The radicals formed and their behavior as a function of the temperature were studied by electron paramagnetic resonance. The radical yield G varies according to the crystallization conditions. It is found that the kinetics of thermal recombination obeys a law of the second order. The activation energy for the recombination is ~20 kcal/mole. (J.S.R.)

2657 RADIOCHEMICAL POLYMERIZATION OF FORMALDEHYDE IN THE SOLID STATE. Claude

Chachaty. J. chim. phys. 57, 680-1(1960) Sept. (In French)

The polymerization of formaldehyde in the solid state initiated by x and γ radiations was studied. At the lowest temperatures studied (T < −165°C) the polymerization had an explosive form. The explosion conditions were deduced from the Semenov theory. The total polymerization velocity is proportional to the irradiation to the 0.7 power. The solid state polymerization of acetaldehyde was also studied, and the conversion percentages for various doses are tabulated. (J.S.R.)

2658 EFFECT OF CHLORIDE IONS ON THE OXIDATION OF INDIGO CARMINE IN AQUEOUS SOLUTION BY γ RAYS OF Co^{60}. INHIBITION OF THE EXTENDED EFFECT. Maria do Carmo Anta (Instituto de Alta Cultura, Comissão de Estudos da Energia Nuclear, Lisbon). J. chim. phys. 57, 728-9(1960) Sept. (In French)

Previous works on the radiochemical oxidation of indigo carmine in aqueous solution have shown that the oxidation is caused by the superposition of two reactions; one, the principal reaction, ends with the irradiation and the other, very slow, lasts for several days after the irradiation has ceased. This extended effect concerns, in 0.8N sulfuric medium, ~40% of the total transformation. It is shown that Cl^- from NaCl and HCl has an inhibitory effect on the two phenomena. The extended effect is completely inhibited by the addition, either before or after the irradiation, of this ion in sufficient concentration. (J.S.R.)

2659 PREPARATION OF GRAFTED COPOLYMERS OF POLYVINYL CHLORIDE BY THE DIRECT RADIOCHEMICAL METHOD. Adolphe Chapiro, Étienne Goethals, and Anna-Maria Jendrichowska-Bonamour (Centre National de la Richerche Scientifique, Bellevue, France). J. chim. phys. 57, 787-92(1960) Sept. (In French)

The radiochemical grafting of styrene and methyl methacrylate on films of polyvinyl chloride was studied. These films were irradiated in the pure monomer or, in the case of methyl methacrylate, in solutions of methyl acetate, CCl_4, and benzene. The kinetics of the grafting of pure styrene and of methyl methacrylate dissolved in benzene and CCl_4 is controlled by the diffusion velocity of the monomer into the film. In the case of grafting of pure methyl methacrylate, the reaction is characterized by a very marked gel effect, but the classical law of the velocity dependence on the square root of the intensity was found. The addition of methyl acetate to this system has the effect of reducing the importance of the gel effect. Benzene and CCl_4 produce a slight effect of sensitization. The conclusions drawn from the grafting kinetics were confirmed by a study of the swelling of the polymer films in the different reaction media. The grafting is controlled by the monomer diffusion only in the systems where this phenomenon is slow, in particular, when the time necessary to attain limited swelling is more than several hours. (tr-auth)

2660 POLYMERIZATION OF METHACRYLONITRILE INDUCED BY IONIZING RADIATION. Yoneho Tabata, Eisuke Oda, and Hiroshi Sobue (Univ. of Tokyo). J. Polymer Sci. 45, 469-73(1960) Aug.

The polymerization of methacrylonitrile induced by ionizing radiation was investigated in bulk in the temperature range from 40 to −196°C. It was found that two different polymerization mechanisms can exist in the polymerization under the same conditions at different temperature regions. The two different polymerization phenomena at room and at low temperature regions proceed by two different mechanisms: ionic and radical. It was found that the apparent activation energy in bulk polymerization is 6.3 kcal/mole in the 40 to −10°C range and about 0.3 kcal/mole for polymerization initiated by high-energy radiation in the −40 to −196°C range. The effects of pyrogallol addition in the polymerization at both temperature regions were investigated. The viscosity of the polymer was measured in acetone solution at 25°C, and the infrared spectrum of the polymer was also measured. It is believed from these experiments that the polymerization at room temperature proceeds by a radical mechanism and that the polymerization in the solid state at low temperature proceeds by an ionic mechanism. An important possibility was emphasized that a stereoregular ionic polymerization would be possible even in solid state of monomer by ionizing radiation. (auth)

2661 POLYMERIZATION IN THE CRYSTALLINE STATE. I. ACRYLAMIDE. T. A. Fadner and H. Morawetz (Polytechnic Inst. of Brooklyn). J. Polymer Sci. 45, 475-501(1960) Aug.

Crystalline acrylamide was irradiated at −78°C with γ rays and the postpolymerization of the irradiated crystals was studied in the temperature range 0 to 60°C. The polymerization rate decays rapidly at low conversion, and the polymer yield is, for long polymerization times, linear in the logarithm of time. The activation energy for the polymerization is 25 kcal/mole. The molecular weight of the polymer depends at a given polymerization temperature on the polymerization time, but remains unchanged over a sixteenfold variation of the irradiation dose. The number of polymer chains, as deduced from the ratio of polymer yield and molecular weight, increases only slightly with conversion, probably owing to chain transfer to monomer. The number of chains calculated in this way is in satisfactory agreement with the number of radicals estimated from electron spin resonance. The ESR signal changes very little during the postpolymerization. The presence of oxygen has little effect on the polymerization. Molten and shock-cooled monomer yields about twice as much polymer as large slowly grown crystals, but the molecular weight of the product is the same, implying that crystal imperfections increase slightly the chain initiation efficiency, but are without effect on chain propagation. Propionamide is isomorphous with acrylamide and forms with it solid solutions over the entire concentration range. The polymerization of acrylamide in solid solutions containing up to 10% propionamide proceeds at a rate indistinguishable from that for pure acrylamide; at higher propionamide concentrations the rate falls off less rapidly than the concentration of the monomer. The molecular weights of polymers obtained from solid solutions approach a limiting value for long polymerization times which is determined by chain transfer to propionamide. Up to 10% propionamide concentration, the limiting polymer chain length is inversely proportional to the propionamide concentration and corresponds to a chain transfer coefficient of 0.022 at 25°C and 0.0064 at 60°C. The high value of the chain transfer coefficient at 25°C is ascribed to the directing influence of the crystal lattice which makes it difficult for a chain to "grow around" a site occupied by a propionamide molecule. The gradual loosening of the lattice restraints at higher temperatures explains the decrease in the chain transfer at higher temperatures. Acetamide is not isomorphous with acrylamide, but a limited amount of acetamide can be incorporated into the acrylamide lattice; the polymerization of such solid solutions exhibits, however, no chain transfer. X-ray-diffraction studies indicate that partially polymerized acrylamide contains separate monomer and polymer phases. Since the chain transfer behavior of propionamide and other evidence points to the importance of lattice control in solid-state polymerization, it is suggested that the

polymer chains grow at a monomer-polymer interface with the growing end anchored in the crystal lattice of the monomer. (auth)

2662 γ-RADIATION-INDUCED HOMOPOLYMERIZATION OF DIETHYL FUMARATE. Richard H. Wiley and D. J. Parish (Univ. of Louisville, Ky.). J. Polymer Sci. 45, 503-7(1960) Aug.

Homopolymerization of diethyl fumarate at 1.57 to 3.75×10^5 rep/hr from a 1000-c Co^{60} source at temperatures from −56 to 22°C has given brittle, solid polymers which are soluble in most organic solvents but insoluble in petroleum ether. These polymers have intrinsic viscosities of 0.123 to 0.178 in benzene and ebullioscopic molecular weights in toluene of 7500 to 9300. The viscosity constant K is 2.97 to 3.21×10^{-4} for an assumed value of a = 0.7. Inhibition by diphenylamine and decreased rate of reaction at low temperature indicate a radical initiation process. (auth)

2663 THE DEGRADATION OF POLYTETRAFLUOROETHYLENE BY IONIZING RADIATION. J. H. Golden (Explosives Research and Development Establishment, Waltham Abbey, Essex, Eng.). J. Polymer Sci. 45, 534-6 (1960) Aug.

Radiation effects on polytetrafluoroethylene were reinvestigated using powder and film samples placed in glass ampules which were degassed and sealed either immediately or after introduction of air or O_2. The ampules were exposed to a 4-Mev electron beam for doses of 1×10^9 rad each while being cooled externally with a water spray, and the gaseous products and films were analyzed by mass and infrared spectroscopy. For films irradiated in vacuum, the infrared spectrum had two bands at 982 and 1350 cm^{-1}, while that for films irradiated in air or O_2 was identical except for additional bands associated with oxygenated structures, e.g., 1757, 3096, and 3472 cm^{-1}. The gaseous irradiation products were examined by mass spectrometry up to mass 330, and a range of saturated fluorocarbon fragments (C_1 to C_8) was found. For irradiation in vacuum, compounds positively identified were CF_4, C_2F_6, C_3F_8, and SiF_4. For irradiation in air or O_2, CF_4, C_2F_6, and SiF_4 were also present, but the amount of fluorocarbon fragments was smaller, and a high proportion of CF_2O was present. For irradiation in both air and vacuum, intense unidentified bands occurred in the 7.5- to 8.5-μ region. A mechanism is proposed for the formation of the irradiation products. (D.L.C.)

2664 CROSSLINKING OF CELLULOSICS BY HIGH ENERGY RADIATION. Frederick C. Leavitt (Dow Chemical Co., Framingham, Mass.). J. Polymer Sci. 45, 536-8 (1960) Aug.

In studies of high-energy radiation effects on cellulosic derivatives in aqueous solution, crosslinking was observed which had not been mentioned in earlier reports on radio-induced degradation of cellulosic polymers. The conditions for crosslinking of cellulosics were studied for nonionic water-soluble cellulose derivatives; viscosity and radiation dose rate were found to have a strong effect on the crosslinking reaction. If the irradiated solution is highly viscous, degradation predominates and the viscosity decreases to a critical value, at which point crosslinking and gelation begin to take place. At extremely low viscosities, the polymer concentration is the significant factor, and degradation occurs again. The effect of the dose rate is also examined. A crosslinking mechanism is proposed in which radiation produces hydroxyl radicals which abstract hydrogen atoms from the anhydroglucose rings, resulting in polymeric free radicals which then crosslink. (D.L.C.)

2665 HOT ATOM CHEMISTRY. I. HISTORICAL INTRODUCTION AND PHYSICS OF HOT ATOM PRODUCTION. Kristián Svoboda (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). Jaderná energie 6, 326-32(1960). (In Czech.)

A survey is given of hot atom chemistry. The object and scope of hot atom chemistry are defined. In the historical introduction a brief outline of the development of hot atom chemistry is given, beginning with Becquerel and Curie discoveries. A continuation is given of hot atom physics which explains the leading idea, and defines the primary, secondary, and tertiary processes. The theory of primary processes, i.e., the mechanism of an activated hot atom being knocked from the molecule, is considered in more detail. (auth)

2666 HOT ATOM CHEMISTRY. II. GAS AND LIQUID PHASE REACTIONS. Jiří Cífka (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). Jaderná energie 6, 333-40(1960). (In Czech.)

A survey is given of contemporary studies of hot atom reactions in the liquid phase. Recently these studies were directed predominantly toward theoretical questions. The theoretical basis for reactions in gases and liquids is explained. The studies are mostly directed toward the behavior of halogens, a disadvantage when deriving general conclusions. (auth)

2667 HOT ATOM CHEMISTRY. III. SOLID PHASE REACTIONS. Karel Pánek (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). Jaderná energie 6, 341-6(1960). (In Czech.)

The study of hot atom chemistry is continued with an analysis of solid phase reactions. An explanation is given of the theoretical basis for the reactions. Results of scientific work in this region are included. (B.O.G.)

2668 THE MECHANISM OF RADIOCHEMICAL DEGRADATION OF AMINO ACIDS. Jiřina Kopoldová, Jindřich Liedšter, and Arnošt Babický (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). Jaderná energie 6, 348-9(1960). (In Czech.)

The radiochemical degradation of α-aminobutyric acid was studied. The main products of radiolysis were determined and the mechanism of their production was derived. (auth)

2669 SELF-DECOMPOSITION OF COMPOUNDS LABELLED WITH RADIOACTIVE ISOTOPES. R. J. Bayly (Radiochemical Centre, Amersham, Eng.) and H. Weigel. Nature 188, 384-7(1960) Oct. 29.

The decomposition of an isotopically labeled compound may result from: (1) primary (internal) radiation effect, i.e., the decomposition or transformation of a molecule caused by the disintegration of one of its unstable nuclei; (2) primary (external) radiation effect, i.e., the decomposition or transformation of a molecule by interactions with nuclear particles; (3) secondary radiation effects, i.e., the decomposition or transformation of a molecule of the labeled compound because of its reaction with reactive species, e.g., free radicals from primary radiation decomposition; and (4) chemical effect, i.e., the decomposition or transformation of the radioactive material caused by chemical reactions not connected with radiation. The magnitude of the radiation effects caused by the decomposition is described. Remedial measures are suggested for the different types of decomposition. The stabilities of uniformly labeled [C^{14}]-sucrose and D-[C^{14}] glucose samples with relatively high specific radioactivities are tabulated. The methods employed in determining the magnitude of the radiation effects for macromolecules are described. (B.O.G.

2670 SEPARATION OF RADIOACTIVE CESIUM BY MEANS OF GLAUCONITE COLUMN ION EXCHANGE.

S. Z. Roginskiĭ, O. V. Al'tshuler, M. I. Yanovskiĭ, E. I. Malinina, and A. E. Morokhovets. Radiokhimiya 2, 431-7 (1960). (In Russian)

The adsorptive properties of various natural and synthetic adsorbers were tested, and glauconite proved to be best for Cs^{137} in solutions with high salt contents. Adsorption by glauconite in mixed cation solutions occurs in the following order: $Mg^{2+} < Ca^{2+} < Sr^{2+} < Na^{+} < La^{3+} < NH_4^{+} < K^{+} < Cs^{+}$. Cation adsorption by glauconite and cation hydration energy were determined. It is shown that with microconcentrations of cesium and macroconcentrations of other cations, adsorption of cesium does not depend on pH from 2.7 to 13. Concentrates with high specific activity were prepared by glauconite adsorption and desorption with $(NH_4)CO_3$ solution. (R.V.J.)

2671 ISOTOPE EFFECTS IN LEAD ISOTOPE β DECAY. V. D. Nefedov, Yu. A. Ryukhin, and M. A. Toropova. Radiokhimiya 2, 458-63(1960). (In Russian)

An isotopic effect was found in the β decay of natural lead isotopes (RaD and ThB) in the compound $Pb^{*}Ph_3Cl$. The effect is produced by variations in the decay scheme of RaD and ThB. The effect appears as a nonequivalent distribution of daughter elements between various chemical configurations. (R.V.J.)

2672 CHROMATOGRAPHIC STUDIES OF CHEMICAL FORMS RaE FORMED IN RaD β DECAY. V. D. Nefedov and S. A. Grachev. Radiokhimiya 2, 464-9(1960). (In Russian)

Chemical recombinations occurring during the β decay of lead isotopes in phenyl compounds were studied by paper chromatography. Processes accompanying central atom decay in lead phenyl derivatives were found which indicate a new form of RaE and other radiobismuth forms. The feasibility of separating daughter products without a carrier is indicated. (R.V.J.)

2673 AN ANALYSIS OF RADIOACTIVE CONTAMINATION ELEMENTS. THEORETICAL BASIS FOR APPLICATION OF COMPLEX AGENTS FOR SEPARATING FRACTIONS OF STRONTIUM-90 FROM THE NATURAL ENVIRONMENT. V. L. Anokhin. Radiokhimiya 2, 470-8 (1960). (In Russian)

A theoretical analysis was made of free-cation and complex-anion distributions in solutions containing calcium, mixtures of calcium and strontium, and mixtures of calcium, strontium, and magnesium in the presence of ethylenediaminetetraacetic acid (EDTA). The amount of strontium bonded in the anion complex increases with the increase of calcium cation in equimolar calcium and EDTA. The Mg^{2+} cation serves as a controlling agent in strontium binding. At equimolar calcium, magnesium, and EDTA, traces of strontium are found in anion complexes in quantities exceeding 80% of the total. (R.V.J.)

2674 EFFECTS OF Po α EMISSION ON CONCENTRATED SOLUTIONS OF SULFURIC ACID. M. V. Vladimirova and Z. V. Ershova. Radiokhimiya 2, 495-9(1960). (In Russian)

The radiolysis of concentrated solutions of H_2SO_4 by α particles from Po^{210} was studied, and the relation between hydrogen peroxide yield and H_2SO_4 concentration was analyzed. (R.V.J.)

2675 CHLORINATION OF BENZENE DERIVATIVES AND SOME OTHER ORGANIC COMPOUNDS UNDER THE INFLUENCE OF GAMMA RAYS FROM COBALT-60. Juichi Imamur and Nobuto Ohta. Tokyo Kôgyô Shikensho Hôkoku 55, No. 8, 31-2(1960) Aug. (In Japanese and English)

The chlorination of benzene derivatives and some other organic compounds under the influence of gamma rays from cobalt-60 (270 c) was studied. The benzene derivatives used were mono- and trichlorobenzenes, phthalodinitrile, nitrobenzene, toluene, xylenes, and phenol. For purposes of comparison, some of the compounds were chlorinated under the illumination by a fluorescent lamp and in a dark place without irradiation. The chlorination of benzene under gamma irradiation at room temperature gives mainly nucleus-addition products. In the case of benzene derivatives having substituents of electron-donor type, nucleus-addition products and nucleus-substitution products are formed in various proportions. The greater the electron-repulsive forces of substituents, the smaller is the amount of nucleus-addition products, but greater is the amount of nucleus-substitution products. If the substituents are of the electron-acceptor type, nucleus-addition products are mainly formed; but it becomes more difficult for chlorination to take place, as the electron-attractive forces of substituents become stronger. The formation of nucleus-addition products is facilitated at low temperatures such as room temperature. At high temperatures such as 80°C, the chlorination of side chain groups is favored. Gamma irradiation has nearly the same influence on the chlorination reactions as fluorescent illumination, and does not give any specific chlorination products. (auth)

2676 INTERMEDIATE PRODUCTS OF THE RADIOLYSIS OF WATER. M. A. Proskurnin and V. A. Sharpatyĭ (Karpov Inst. of Physical Chemistry, [USSR]). Zhur. Fiz. Khim. 34, 2126-8(1960) Sept. (In Russian)

In the radiolysis of saturated alkali nitrate solutions, an increase in nitrate concentration induces an increase in $G_{NO_2^-}$. Moreover, "constant" yields of nitrite of 4.3 and 9 equiv./100 ev (i.e., two "steps" along the curve of the function $G_{(-Ak)} \sim [Ak]$) were observed in solution concentrations from 5×10^{-4} to 5×10^{-2} M and 1 to 5 M. It was assumed that the first "step" results from the participation of hydrogen radicals from ionized water molecules in reactions with nitrate ion. The second step is a result of excited ones. Variations in pH from 4 to ~14 do not affect $G_{NO_2^-}$ at a nitrate concentration of 10^{-2} M, which is explained by H radicals entering the cell wall surrounding the excited water molecule. The dependence of $G_{NO_2^-}$ on (NO^-) in various saturated solutions is plotted at 70°C. In order to increase the $G_{NO_2^-}$, a conjugated acceptor (glycerine) is introduced into concentrated nitrate solutions. In this case the $G_{NO_2^-}$ in 2 to 5 M nitrate solutions reaches 12 equiv. The curve of $G_{NO_2^-} \sim NO_3^-$ exhibits a "third" step. Obviously, two types of excited water molecules, dissociating and nondissociating, exist. The method of conjugated acceptors enables the observation of excited water molecule participation reactions. The lifetime of triplet excited water molecules is 10^{-9} sec. (R.V.J.)

2677 SOURCE MATERIAL FOR RADIOCHEMISTRY. Nuclear Science Series Report Number 27 (rev. 1). Subcommittee on Radiochemistry, Committee on Nuclear Science. NRC Pub. No. 825. National Research Council. Committee on Nuclear Science. July 1960. 43p.

An extensive bibliography of 240 references with brief descriptions is presented on radiochemistry. The bibliography was compiled from lists submitted by the Subcommittee on Radiochemistry, with emphasis on articles, books, and reports of a review nature. Many AEC reports are listed. The bibliography is divided into nine parts on the basis of (1) books; (2) collections of radiochemical procedures; (3) ion exchange and solvent extraction; (4) activation analysis; (5) nuclear geochemistry, oceanography, and geochronology; (6) counting techniques; (7) nuclear data

compilations; (8) sources of radioisotopes; and (9) laboratory design and safety. (D.L.C.)

2678 IMPROVEMENTS IN IRRADIATION OF POLYMERS. (to United States Rubber Co.). British Patent 852,613. Oct. 26, 1960.

A method for radioinduced vulcanization of polyvinyl chloride polymers and copolymers is presented in which 1 to 4 parts sulfur is mixed with 100 parts vinyl chloride resin that may or may not be plasticized, and the mixture is irradiated to 10- to 40-watt-hr dose per pound. In this way, the polymers' tensile strength at high temperatures may be increased. Two examples of the method are given in which plasticized Marvinol polymers were irradiated with 2-Mev electrons. (D.L.C.)

2679 IMPROVEMENTS RELATING TO THE MANUFACTURE OF PLASTICS. Soloman Harris Pinner and William Henry Thomas Davison (to T. I. (Group Services) Ltd.). British Patent 853,795. Nov. 9, 1960.

A method for radioinduced polymerization of monomers is given in which the irradiations are carried out at −200 to −50°C, where ionic polymerization predominates over free-radical polymerization. The advantages of ionic polymerization are that the molecular weights of the polymers obtained are greater than those of polymers produced at normal temperatures and that the type and intensity of the radiation used are not critical. This method is applicable to two groups of substances: (1) olefinic monomers where 2 or 3 of the groups attached to the carbon atoms joined by a double bond are hydrogen atoms, and (2) three- or four-membered homocyclic or heterocyclic ringed compounds. However, preferred monomers are those which are polymerizable only through ionic initiation; examples are isobutylene, α-methyl styrene, 3:3-bis(chloromethyl)-oxyacyclobutane, and ethylene oxide. Sensitizers for the reaction were found and fall into two classes: (1) soluble and (2) inert and insoluble materials, of which iodine and silica are examples, respectively. Seventeen examples of this method are given in which a variety of polymerizations are carried out with and without sensitizers. (D.L.C.)

2680 CURING OF RUBBER LATEX AND THE PRODUCTION OF ARTICLES THEREFROM. Donald Whitworth Pounder (to Dunlop, Rubber Co., Ltd.). British Patent 853,926. Nov. 9, 1960.

A method is given for curing latex which does not require heat treatments and which yields a product having a strength greater than that of products obtained from latex prevulcanized in other ways. The method involves the application of high-energy radiation (>0.1 Mev) to an aqueous dispersion of latex, forming a shaped article from the irradiated latex, and allowing the article to dry; it may be applied to all vulcanizable natural or synthetic rubber lattices. Examples are given in which the strength properties of irradiated natural and synthetic (butadiene-styrene) rubber lattices are compared with those of nonirradiated controls. (D.L.C.)

2681 CATALYTIC HYDROCARBON RADIOCHEMICAL CONVERSION PROCESS. (to Esso Research and Engineering Co.). British Patent 853,950. Nov. 16, 1960.

A method for the conversion of liquid hydrocarbon oils by irradiation in the presence of a catalyst is presented in which the catalyst contains adsorbed water, preferably 25% or more. The water greatly influences the type and amount of products obtained, a substantial amount of oxygenated organic compounds being produced under these conditions. In a particular configuration of this method, the catalyst is of the gel type such as is obtained from drying hydrated oxides like alumina, silica, zirconia, etc. The catalyst carries a hydrogenating agent (Pt, Mo, Pd, and compounds thereof) and a radiochemical accelerator (B^{10} or Li^6). The irradiations should be carried out in a gamma flux $\geq 10^5$ r/hr or a neutron flux $\geq 10^8$ neutrons/cm^2/sec. A flowsheet is presented for the process, and data are given for the products of irradiation of various oils with water-containing catalysts. (D.L.C.)

2682 IMPROVEMENTS IN GRAFT POLYMERIZATION UTILIZING IONIZING RADIATION. (to Centre National de la Recherche Scientifique). British Patent 853,970. Nov. 16, 1960.

More than one monomer can be grafted on a polymer by application to the polymer after it has been irradiated in the presence of oxygen to form active centers. Ways for doing this are discussed. One of the simplest ways is by interrupting the contacting steps before all the active centers are used up, letting the final step consume the rest of the centers. Another way is by temperature control; it is possible in this manner to control the areas where grafting occurs, e.g., for a polymer having amorphous and crystalline regions, grafting can be effected on the amphorous regions first by conducting the contacting step at a temperature below the melting point of the crystalline regions. Three examples of this method are given in which methyl methacrylate and acrylonitrile are grafted onto polyethylene and polypropylene. (D.L.C.)

2683 IMPROVEMENTS IN GRAFT POLYMERIZATION USING IONIZING RADIATION AS THE GRAFT POLYMERIZATION INITIATOR. (to Centre National de la Recherche Scientifique). British Patent 853,971. Nov. 16, 1960.

A method is described for eliminating or suppressing homopolymerization of the monomer in radioinduced polymerization of a monomer in a polymer by using a polymerization inhibitor whose effect is more on the monomer than on the polymer. Various ways of obtaining this selective effect are described. Two examples of this method are given in which the polymer was polyvinyl chloride; the monomer, acrylonitrile; and the inhibitor, oxygen. (D.L.C.)

Raw Materials and Feed Materials

2684 (CEA-1528) UTILISATION DE LA FLUORESCENCE DANS UN LABORATOIRE DE TRAITEMENTS DE MINERAIS D'URANIUM. (Use of X-Ray Fluorescence in a Laboratory for the Treatment of Uranium Ores). H. Guillet. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 31p.

A brief description is given of some aspects of the experience gained over a year during which x-ray fluorescence was used at the laboratory of the present Section Autonome d'Etudes, Recherches et Applications Chimiques of the Commissariat à l'Énergie Atomique. A standard is tested daily to ensure reproducibility. The observations made during the months from Dec. 1958 to May 1959 are described. In acid leaching of uranium ores, the residues are analyzed by x-ray fluorescence directly in powder form. Fixation and elution of vanadium on ion-exchange resin were also studied. (auth)

2685 (NLCO-820) SUMMARY TECHNICAL REPORT FOR THE PERIOD JULY 1, 1960 TO SEPTEMBER 30, 1960. National Lead Co. of Ohio, Cincinnati. Oct. 28, 1960. 83p. Contract AT(30-1)-1156. OTS.

Further laboratory tests have verified that ammonium hydroxide may be added at a maximum concentration of 0.15 molar during re-extraction to enhance uranium recovery without subsequent precipitation of uranium com-

pounds during concentration of the uranyl nitrate solution. X-ray-diffraction data were obtained for $NH_4UO_2(NO_3)_3$, $(NH_4)_2UO_2(NO_3)_4$, and $(NH_4)_2UO_2(NO_3)_4 \cdot 2H_2O$. Thermogravimetric and differential thermal analyses indicate that $NH_4UO_2(NO_3)_3$ decomposes in a single reaction step to yield γ-UO_3. A liquid adsorption procedure is described for the surface area determination of UO_3, UO_2, and UF_4. A procedure is described for the determination of vanadium and molybdenum in UF_4. Laboratory equilibration tests and pilot plant two-inch column tests have indicated that low-grade 0.94 enriched uranium residues may be upgraded for conversion to UF_4 in the Winlo process by a liquid-liquid extraction process using 10 or 15% tri-n-butyl phosphate in kerosene. The effect of temperature gradients in small-scale reduction vessels on crude derby yield, preheat time and slag-metal separation are described from experimental data. An analysis of variance statistical evaluation of chemistry data from ingots cast at various furnace pressures is presented. Two types of charges were used: 100% dingot remelt stock and 50% heat-shocked Grade III derbies-50% briquettes. A survey was made of the hydrogen content of uranium ingots, alpha heat treated slug blanks, beta heat treated slug blanks, and finished fuel element cores. Development of techniques to cast dilute uranium-silicon alloys is described. Silicon contents above 500 ppm show a marked refinement in the as-cast grain size of the ingots. Fabrication techniques for NPR coextrusion billets with satisfactory quality were developed. Mark VII-A slugs were beta heat treated by the salt-oil process both in racks and two at a time. The rack quenched slugs exhibited less warp, more uniform grain size, and slightly smaller grain size than did the slugs quenched two at a time. None of the production heat treating processes in use at National Lead Company of Ohio was found to propagate or widen slug surface defects. Nitric acid pickling of slugs after heat treatment does enlarge slug surface defects. The effects of sample size, sample preparation, analytical techniques, and equipment on the determination of hydrogen in uranium metals are being determined. (auth)

2686 (NP-9249) MONTHLY REPORT OF DEVELOPMENT, AUGUST 1960. Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa. 25p. (D-60-8).

Results of atmospheric leach tests on mill-head samples received from Beaverlodge are shown. Comparative leach test results are shown on a mill-head sample using synthetic and recarbonated barren leach solutions. The effects of extended carbonate leach time on extraction from Beaverlodge mill heads were investigated. Results are presented of carbonate pressure-leach tests on electronically sorted Beaverlodge ore. Further work was done on the effect of oxidizing agents on the coprecipitation of vanadium with uranium from Beaverlodge pregnant liquor with vanadium either in the tetravalent or pentavalent form. Data are presented on sodium consumption in amalgam reduction tests on Beaverlodge pregnant and barren solutions. Several runs were made in the 6-kev converter type induction furnace with the object of preparing 50% by weight U–Fe alloy. Several runs were made in an attempt to reduce U_3O_8 with magnesium. Equipment for the direct conversion of UF_6 to UO_2 is shown. (W.L.H.)

2687 (NP-9362) MONTHLY REPORT [OF] DEVELOPMENT, SEPTEMBER 1960. Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa. 14p. (D-60-9).

Results of atmospheric leach tests on July mill head samples received from Beaverlodge are shown. A sample of chlorite with a U_3O_8 content 0.0002%, was leached under standard autoclave conditions, with water only, to determine the extraction of water soluble salts. Further work was done on the precipitation of vanadium from high-vanadium-pregnant solutions by addition of iron salts. During periods of high fluoride additions to the refinery feeds, there were indications that the fluoride ion increased the uranium losses. Tests were started to expand and consolidate present knowledge on the effect of heat treatment on the microstructure of uranium metal. The alloying of iron and uranium in graphite crucibles by induction melting is reported. The density of UO_2 produced from cast ADU pellets was studied. (W.L.H.)

2688 (TID-5295(Del.)) CURRENT COMMISSION METHODS FOR PRODUCING UO_3, UF_4, AND UF_6. Mallinckrodt Chemical Works, St. Louis; National Lead Co. of Ohio, Cincinnati; New Brunswick Lab., AEC, N. J.; and Union Carbide Nuclear Co. K-25 Plant, Oak Ridge, Tenn. Jan. 1956. Decl. with deletions Nov. 5, 1959. 281p. OTS.

The production of UO_3 by the Mallinckrodt ether, TBP extraction, and TBP hexane processes is described. The conversion of UO_3 to UF_4 in vibrating tray reactors in a two-step reduction-hydrofluorination process is described. A general design study and an equipment layout scheme for a plant for producing UF_4 are contained. Thermobalance and modified Fox reactivity tests for evaluating the properties of UO_3 are described. Spectrochemical procedures for the analysis of UO_3, UF_4, and UF_6 are reviewed. Methods of treatment for uranium recovery from scrap materials generated during the production of UO_3 and UF_4 are described. The method for the continuous conversion of UF_4 to UF_6 in tower reactors is described. The design and operation of a multiple cell fluorine plant are presented. (C.J.G.)

2689 (TID-5886) EXPANSION PROGRAM AT ST. LOUIS AREA. Project No. 224-5066A—Project History and Completion Report. Saint Louis Area Office, AEC. Oct. 1960. 358p. OTS.

A brief résumé is presented highlighting the more pertinent features, factors, and problems encountered in the design and construction of the new feed materials plant at Weldon Spring, Mo. Also covered is the expansion of the feed materials plant at Destrehan Street, St. Louis, Mo. Costs and other significant data pertaining to the project were included. (W.L.H.)

2690 BEHAVIOR OF MINERALS ACCOMPANYING URANIUM MINERALS DURING ACID LEACHING. G. M. Nesmeyanova and N. K. Chernushevich. Atomnaya Energ. 9, 137-8(1960) Aug. (In Russian)

The behavior of magnetite, hematite, limonite, siderite, pyrite, and covellite was studied during leaching by sulfuric acid, nitric acid, and sulfuric acid with manganese dioxide. The solvent concentration varied from 1 to 400 g/liter. The results of chemical analyses of the tested minerals are tabulated. The mineral grains were 0.15 mm; all tests were made at 90°C. (R.V.J.)

2691 PRODUCTION OF UF_4 FROM REFINERY SCRAP MATERIALS. E. O. Rutenkroger, T. J. Collopy, J. H. Cavendish, and M. A. De Sesa (National Lead Co. of Ohio, Cincinnati). J. Metals 12, 866-70(1960) Nov.

Laboratory and pilot-scale tests show that both low-grade and high-grade uranium scrap materials can be converted to UF_4 in the Winlo process. Low-grade scrap materials should be upgraded in quality by amine solvent extraction or conversion to UAP. Many high-grade scrap materials can be treated directly by a HCl dissolution–Winlo pre-

cipitation process. Winlo green salt can be blended in the hydrated form with production green salt prior to reduction to metal. Winlo green salt alone can be reduced to metal if it is dehydrated and ground. Processing of scrap material directly to green salt by the Winlo process will reduce the over-all costs of metal production and relieve the load on the chemical processing plants by eliminating recycle of scrap material. (auth)

2692 EXPERIMENTS ON THE PRODUCTION OF METALLIC URANIUM BY REDUCTION OF URANIUM TETRAFLUORIDE WITH THE AID OF METALLIC CALCIUM. Mieczysław Perec, Franciszek Mucha, and Apoloniusz Dębiński (Inst. of Nuclear Research, Warsaw). Nukleonika 5, 559-68(1960). (In Polish)

A method for the reduction of uranium tetrafluoride and vacuum refining of crude uranium was developed. On the basis of experimental results, an apparatus for calciothermic reduction of UF_4 under reducer pressure was constructed. Reduction tests on a larger scale (with a charge of 11 kg UF_4) confirmed anticipated advantages of the method. (auth)

2693 RECENT DEVELOPMENT IN THE CHEMICAL PROCESSING OF URANIUM ORES IN FRANCE. R. Bodu (Commissariat à l'Énergie Atomique, Saclay, France). Rev. ind. minérale 42, 10p.(1960) Aug. (In French)

The processing of uranium ore in France has entered a second phase of development in which one plant (Ecarplère) processes 300,000 tonnes per year of an assay of 0.1% and another (Bessines) handles 600,000 tonnes of 0.15% assay. In these plants the uranium is dissolved in H_2SO_4, taken up on ion exchange resins, eluted with HCl, and precipitated as magnesium uranate. A tendency toward the use of a lime preconcentration of H_2SO_4 liquors is described. This step involves lime precipitation until a pH of 6.5 to 7 is reached. A prior precipitation at pH 2.7 serves to eliminate some impurities. The preconcentrated liquor can then be processed by the alkali (Na_2CO_3) or acid (extraction) method. The reasons for choosing the lime process in existing and proposed French plants are pointed out, and a detailed description of the process applied in one existing plant (Gueugnon) and one proposed plant (Forez) is given. (T.R.H.)

2694 RECOVERY OF URANIUM VALUES FROM URANIUM-BEARING RAW MATERIALS. (to United Kingdom Atomic Energy Authority). British Patent 851,991. Oct. 19, 1960.

An improved acid leaching process for extracting small amounts of uranium from raw materials (ores and concentrates) is described in which the iron salts in the leach solution are replaced with manganese dioxide for economy and for more effective oxidation of uranium to the hexavalent state. It is desirable, however, to have a small amount of soluble iron present to catalyze the oxidation reaction and thus speed up its rate; and in the case of ores having a high phosphate content, it is necessary to add more ferric ions to complex the phosphate in order to prevent it from precipitating with the uranium when base is added. Three examples and a flowsheet of the process are presented. (D.L.C.)

Separation Processes

2695 (CEA-1426) EXTRACTION ET PURIFICATION DU PLUTONIUM PAR UNE AMINE TERTIAIRE. (Extraction and Purification of Plutonium by a Tertiary Amine). M. de Trentinian and A. Chesne. France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay. 1960. 14p.

Trilaurylamine diluted with a paraffinic solvent (dodecane) was studied as part of the research dealing with the separation and purification of plutonium. The physical properties (solubility of nitrates in the amine as a function of temperature) and the resistance to radiation of this substance were examined. The extraction characteristics of nitric solutions of plutonium, uranium, and certain fission products are given as a function of concentration of the various ions in solution and valency states. A method of plutonium purification based on these results is presented. (auth)

2696 (CEI-55) CONCENTRATION AND PURIFICATION OF PLUTONIUM SOLUTIONS BY MEANS OF ION-EXCHANGE COLUMNS. R. W. Durham and A. M. Aikin. Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 12, 1953. Reprinted July 1960. 17p. (AECL-722). AECL.

Equilibrium experiments using Dowex 50 ion-exchange resin and nitric acid solutions of Pu^{3+}, UO_2^{2+}, Fe^{2+} cations have yielded values for the absorption affinities for these ions. Trivalent plutonium was found to be far more strongly absorbed than UO_2^{2+} and Fe^{2+}. Column studies have shown that uranium can be completely separated from plutonium even when the initial concentration of uranium is very much greater than that of the plutonium. A plutonium concentration increase of about fiftyfold can be obtained from solutions about 10^{-3}M in plutonium and 1.0M in nitric acid. The equation

$$K_{Pu}^{3+} = \frac{X_R(1-X_S)^3C_S^2}{X_S(1-X_R)^3C_R^2}$$

for estimating the maximum amount of plutonium taken up by a column of resin of unit volume from a solution of total equivalent concentration, C_S, has been shown to hold for values of C_S up to 3 equivalents per liter. X_R, the equivalent fraction of plutonium on the resin, is the number of equivalents of plutonium absorbed by the resin divided by the total capacity of the column. X_S, the equivalent fraction of plutonium in solution, is the equivalent concentration of plutonium divided by the total equivalent concentration of cations in solution. C_R is the total capacity of the resin in milliequivalents per gram of dry resin. (auth)

2697 (CF-60-3-119) TRANSFER OF URANYL ION ACROSS A WATER–TBP INTERFACE. C. V. Chester. Oak Ridge National Lab., Tenn. Mar. 31, 1960. 12p. OTS.

Paper presented at UCC Mass Transfer Meeting Held in Buffalo, New York.

The steady-state transfer of uranyl nitrate across a quiescent interface between water and tri-n-butyl phosphate in kerosene was studied in an attempt to elucidate the mechanism of transfer in solvent-extraction operations. A steady-state gradient was established across an interface by maintaining a saturated solution a few millimeters to one side and zero concentration a few millimeters to the other in a specially constructed cell. Photographic photometry of concentration profile permitted point analyses up to within 100 μ of the interface. Extrapolation of the steady-state profile to the interface showed the two phases to have the same concentration ratio obtained by batch equilibration. This fact showed that there is no hindrance of the transfer to the organic phase in this system other than diffusion to the interface. The reactions at the interface are sufficiently fast to maintain equilibrium. It is likely that many of the interphase "kinetic" data are

simply diffusion measurements with various interfacial areas and various degrees of mixing of the phases adjacent to the interface. (auth)

2698 (HW-66884) DECLADDING OF ZIRCALOY CLAD URANIUM DIOXIDE FUELS BY ACIDIC FLUORIDE SOLUTIONS. R. F. Maness. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Sept. 23, 1960. 14p. Contract W-31-109-eng-53. OTS.

A summary of experimental work is presented which shows the feasibility of using a decladding solution composed of HF and low concentrations of HNO_3 for removal of Zircaloy from UO_2 fuel elements. (J.R.D.)

2699 (KAPL-2000-11(p.III.9-III.12)) SEPARATION OF MICRO AMOUNTS OF HAFNIUM FROM MACRO AMOUNTS OF ZIRCONIUM BY CATION EXCHANGE. F. W. Walker. Knolls Atomic Power Lab., Schenectady, N. Y.

A procedure for separation of hafnium from zirconium is presented. A Zircaloy-2 specimen was dissolved with HF. The mixture was then diluted and adjusted to the correct pH. Dowex-50-X12 cation-exchange resin was conditioned by a few acid-base cycles and then slurried into the column. The Zircaloy-2 solution was then allowed to percolate onto the column at an elution rate of ~50 ml/hr. Then 1750 ml of 1.0N H_2SO_4 was passed through the column at an elution rate of 100 to 150 ml/hr; this eluant removed most of the zirconium. Then 400 ml of 2.0N H_2SO_4 was passed through the column at the same elution rate. This eluant removed more zirconium but also removed some of the hafnium (this was necessary in order that the hafnium be sufficiently free of zirconium). Finally, 0.05M oxalic acid was added to the column. The first 50 ml was discarded, and the next 150-ml fraction was collected. This fraction was evaporated to about 1 to 2 ml, and an aliquot was taken for mass-spectrographic analysis. (W.L.H.)

2700 (ORNL-2934) SULFEX-THOREX AND DAREX-THOREX PROCESSES FOR THE DISSOLUTION OF CONSOLIDATED EDISON POWER REACTOR FUEL: LABORATORY DEVELOPMENT. L. M. Ferris and A. H. Kibbey. Oak Ridge National Lab., Tenn. Nov. 9, 1960. 27p. Contract W-7405-eng-26. OTS.

Modified flowsheets, based on laboratory-scale studies, are presented for batch dissolution of Consolidated Edison power reactor fuel. The stainless-steel jacket may be dissolved in either boiling 5M HNO_3–2M HCl (Darex process) or boiling 6M H_2SO_4 (Sulfex process). In each case a waste solution containing about 50 g of stainless steel per liter is formed. With ThO_2–UO_2 core pellets, whose density is about 90% of theoretical, the uranium lost during decladding is expected to be less than 0.1% with either method. The high-density fuel pellets will be dissolved in 200% excess of boiling 13M HNO_3–0.04M NaF containing 0.04 or 0.1M $Al(NO_3)_3$ after decladding by the Darex or Sulfex processes, respectively. Core dissolution will require at least 25 hr and will yield a solution containing about 1M thorium and about 9M HNO_3. The dissolution time could be shortened slightly by decreasing the aluminum concentration in the dissolvent or by adding about 0.5M $Fe(NO_3)_3$. Sulfate ion, which might be present after Sulfex decladding, decreased the core dissolution rate. The rate of dissolution of the fuel pellets was inversely proportional to the density of the pellets; the initial 10-min rate of dissolution in boiling 13M HNO_3–0.04M NaF–0.1M $Al(NO_3)_3$ of 95% ThO_2–5% UO_2 pellets decreased from about 16 to 2 mg $min^{-1}cm^{-2}$ as the pellet density increased from 60 to 94% of theoretical. The solubility of stainless steel in sulfuric acid at 25°C decreased from 80 to 40 g/liter as the acidity increased from 4 to 10N. (auth)

2701 (TID-6416) SYNTHETIC RESINS FOR LIQUID-LIQUID EXTRACTOR CONSTRUCTION. Report 234. Period [covered]: August 31, 1958 to February 9, 1959. Patrick A. Lincoln. Michigan Chemical Corp., St. Louis, Mich. Apr. 2, 1959. 8p. Project No. 942. OTS.

A study of the resistance of selected synthetic resins to the solutions used in the liquid-liquid extractor was conducted to find a suitable material of construction for this process. A Fiberglas reinforced polyester resin, Haveg 7710, was found to be satisfactory for tank and extractor construction. Baked phenolic coatings offered excellent protection for metallic parts but must be protected from accidental mechanical damage. (auth)

2702 (CEA-tr-A-710) SÉPARATION DU TELLURE ET DE L'IODE À DIVERS DEGRÉS D'OXYDATION SUR FORMES RÉDOX DE RÉSINE. (Separation of Tellurium and Iodine of Different Degrees of Oxidation on the Redox Form of Resin). R. Münze. Translated into French from J. prakt. Chem. (4) 7, 262-7(1959). 13p.

A description is given of a process for continuous separation of iodine at different degrees of oxidation from Te^{137} by ion exchange. The tellurite anion is fixed on the stannous form of KPS 200 resin and the iodine appears in the eluate. The first part of the eluate contains the short-lived isomer of Te^{137}. (T.R.H.)

2703 (CEA-tr-X-219) SÉPARATION DES PRODUITS DE FISSION PAR L'EMPLOI DES RÉSINES ÉCHANGEURS ANIONIQUES DU TYPE ACIDE OXALIQUES. (Separation of Fission Products Using Ion Exchange Resins of the Oxalic Acid Type). Yajima, Siho, and Yamaguchi. Translated into French by Sen-Sik Minn from Bunseki Kagaku 7, 721(1958). 5p.

Experiments are described in which attempts were made to separate fission products using ion-exchange resins of the oxalic acid type. A column of Dowex-1X 7.5 of 50 to 100 mesh was treated with fission-product solution in 0.5% NH_4Cl at pH 6. This was followed successively by a distilled-water wash, 0.2N HCl, 0.5N HCl, 1.0N HCl, and 7N HNO_3. For the case of Ru^{106}–Rh^{106} about 5% of the product passed through. (T.R.H.)

2704 (UCRL-Trans-551(L)) UTILIZATION OF ION-EXCHANGE CHROMATOGRAPHY FOR THE SEPARATION OF TRANSURANIC AND RADIOACTIVE RARE-EARTH ELEMENTS. B. K. Preobrazhenskiĭ. Translated from Khim. Nauka i Prom. 4, 521-6(1959). 16p. JCL or LC.

The separation of actinide and lanthanide elements by ion-exchange chromatography is reported. Various resins are discussed along with various complexing agents. Elution of the elements from the ion-exchange resins is discussed in some detail. (W.L.H.)

2705 EXTRACTION OF URANIUM FROM SLIMES AND SOLUTIONS BY MEANS OF SORPTION. B. N. Laskorin. Atomnaya Energ. 9, 286-96(1960) Oct. (In Russian)

The characteristics of various ionites utilized in selective uranium absorption are described, and the behavior of a series of accompanying elements is analyzed. Various schemes of uranium sorption permitting treatments of ore pulp with up to 40% solids are described. Further improvement of sorption technology using improved kinetics and high selectivity is discussed. (R.V.J.)

2706 LIQUID-LIQUID EXTRACTION. EFFECT OF THE VARIATION OF THE PHYSICAL PROPERTIES ON THE OPERATION OF PULSE COLUMNS. J. Durandet (In-

stitut Français du Pétrole, [Paris]) and X. Talmont. Bull. inform. sci. et tech. (Paris) No. 42, 17-28(1960) July-Aug. (In French)

The extraction of uranyl nitrate from aqueous and organic solutions is investigated. The variation, as a function of the height, of the density and the interfacial tension of liquids flowing in the column is studied. Its effect on the capacity and efficiency of the apparatus is examined. An interpretation of the local efficiency variation is given which connects the H.E.T.S. variation with the physical properties. The column performance with tributylphosphate (TBP) at different dilutions is then investigated. The best results are obtained with a solvent containing 20 to 30 vol. % TBP. (tr-auth)

2707 NON-AQUEOUS METHODS, FUTURE METHODS IN THE REPROCESSING OF NUCLEAR FUELS. J. Fuger (Institut Interuniversitaire des Sciences Nucléaires, France). Ind. chim. belge 25, 937-43(1960) Aug. (In French)

The different methods of nuclear-fuel reprocessing are briefly reviewed. Although many technological problems are yet to be solved, nonaqueous methods appear to better meet the present and future needs, principally because fuels with a high concentration of fissile isotopes are being increasingly used. (auth)

2708 SORPTION OF URANIUM, VANADIUM, AND PHOSPHORUS BY STRONG BASE ANIONITE AV-17. A. V. Gordievskiĭ and V. I. Savel'eva. Khim. Prom. No. 3, 28-32(1960). (In Russian)

Almost complete separation of uranium from vanadium (96 to 97%) and phosphorus was achieved with carbonate and hydrochloride solutions in anionite AV-17 (synthesized by chloromethylate styrene copolymer and benzodivinyl amination). More than 99% of the uranium absorbed by the resin was effectively washed out by 2M NaCl or 1M $NaNO_3$ solution containing 0.05M Na_2CO_3, whereas 2M nitric or hydrochloric acid solution mixed with 1M NH_4NO_3 + 0.1M HNO_3 will elute uranium adsorbed from sulfuric acid solutions. From hydrochloric acid solution, uranium is easily washed out by distilled water. The AV-17 anionite is chemically stable in hydrochloric acid up to 10M and nitric acid up to 8M. (R.V.J.)

2709 THE INFLUENCE OF NITRIC ACID CONCENTRATION OF PLUTONIUM(IV)—TETRABUTYLAMMONIUM NITRATE COMPLEX INTO MIXED SOLVENT. Mieczysław Taube (Inst. of Nuclear Research, Warsaw). Nukleonika 5, 531-9(1960). (In English)

Tetrabutylammonium nitrate (TBAN) diluted by a mixture of nonpolar (benzene and carbon tetrachloride) and polar diluents (toluene, dibromoethane, and chloroform) was used as extractant for Pu(IV) complex extraction from nitric acid solutions. As the volume fraction of nonpolar diluent in a mixture (benzene or toluene + chloroform or dibromoethane) and nitric acid concentration increased, a rise in the distribution coefficient of Pu(IV) complex was observed. Interaction of the polar Pu(IV)–TBAN complex with the diluent–HNO_3 solvate can at least partly explain phenomena observed. (auth)

2710 DISTRIBUTION OF ZIRCONIUM IN EXTRACTION OF TRIBUTYL PHOSPHATE. N. M. Adamskiĭ, S. M. Karpacheva, I. N. Mel'nikov and A. M. Rozen. Radiokhimiya 2, 400-10(1960). (In Russian)

The distribution of microquantities of zirconium between hydrous nitric acid solutions and extraction agent (0.736 M solution of TBP in saturated hydrocarbons) was studied at 23, 40, and 70°C. The distribution of zirconium was also determined in the above systems when uranyl nitrate was present at 20 and 70°C. During nitric acid extraction the distribution coefficient of zirconium increases with increased temperature and nitric acid concentration. The apparent zirconium distribution coefficients were calculated. The activity constants of zirconium in aqueous solution were evaluated. An increase of nitric acid concentration first depresses, then increases, the activity factor. Small uranyl admixtures to aqueous solutions (10 to 20 g/liter) reduce zirconium distribution coefficients; this reduction is due to the dissociation of uranyl and the diminishing activity factor in the organic phase. The apparent zirconium distribution coefficients in the presence of uranyl nitrate were calculated. An increase in ionic strength first reduces and then increases the constants. (R.V.J.)

2711 DISTRIBUTION OF BUTYL PHOSPHORIC ACID BETWEEN AQUEOUS SOLUTION AND TRIBUTYL PHOSPHATE. A. P. Ilozhev, I. V. Poddubskaya, and A. M. Rozen. Radiokhimiya 2, 411-18(1960). (In Russian)

The effects of monobutyl phosphoric acid and dibutyl phosphoric acid concentrations on their distributions between water and 20% TBP solution in saturated hydrocarbon mixtures were investigated. It was found that stronger acid concentrations increased the distribution coefficients. The relation between monobutyl distribution coefficients and $HClO_4$ concentrations in the aqueous phase at a constant ionic strength of I = 1 was determined. With the increase of $HClO_4$ concentration in the aqueous phase, the distribution coefficient of MBP reaches a maximum and with the increase of HNO_3 concentration the distribution coefficient of DBP first increases (up to HNO_3 concentration equal to ~1 m/liter) and then remains constant. Qualitative and thermodynamic analyses of the data are included. (R.V.J.)

2712 PREPARATION OF RADIOACTIVE CESIUM ISOTOPE CONCENTRATIONS FROM SOLUTIONS WITH HIGH-CONTENT OF ADMIXTURE SALTS. S. Z. Roginskiĭ, E. V. Malinina, M. I. Yanovskiĭ, O. V. Al'tshuler, and A. E. Morokhovets. Radiokhimiya 2, 438-45(1960). (In Russian)

Descriptions are given of an effective separation of radioactive cesium from potassium and sodium salt solutions. A method was developed for preparing a ferrocyanide cement absorber. The application of ferrocyanide as a cesium absorber is discussed. It is shown that ferrocyanide cesium concentrates can be used in the preparation of γ sources for radiography and therapy. (R.V.J.)

2713 REACTIONS OF SEMI-CALCINED DOLOMITE (MAGNOMASS) WITH MICRO-CONCENTRATIONS OF VARIOUS ELEMENTS IN AQUEOUS SOLUTIONS. V. F. Bagretsov and V. V. Pushkarev. Radiokhimiya 2, 446-50 (1960). (In Russian)

Investigations of the effects of dolomite calcination, fineness of crushing, pH of initial solution, and admixtures of various salts on the separation of cesium, cerium, ruthenium, zirconium, and niobium isotopes show that phosphate ions are capable of completely separating all the above elements except cerium. Various mechanisms of interaction are discussed. It was found that ions of simple salts ($CaCl_2$ and $NaNO_3$) do not interfere with the separation of radioactive elements. In the system, ruthenium with PO_4^{3-} and NH_4^+ and zirconium with PO_4^{3-} form complex formations which cannot be sorbed by either lime or dolomite. (R.V.J.)

2714 MOLECULAR SIEVES (PREPARATION, PROPERTIES, APPLICATION). V. Ya. Nikolina, I. E. Neĭmark, and M. A. Piontkovskaya (Inst. of Physical Chemistry, Academy of Sciences, Ukrainian SSR and Scientific Re-

search Inst. of Basic Chemistry). Uspekhi Khim. 29, 1088-1111(1960) Sept.

Natural or synthetic zeolites consist of a hydrated aluminosilicate skeleton containing either a monovalent ion such as Na, K, or Li, or a divalent ion such as Ca, Sr, or Ba. Zeolites contain a rigid structure, a layered structure, or a semirigid structure. Synthetic zeolites are produced most frequently by autoclaving a sodium aluminate solution with a suspension of silicic acid at a pH of 8 to 10.5 with a temperature of 85 to 110°C, and then dehydrating the product. Since these artificial zeolites have a controlled diameter of 4A, 5A, or higher (Linde 13X), they are characterized by selectivity in absorbing only smaller molecules and by high adsorptive capacity at higher temperatures. Since they are polar adsorbents, they have a great affinity for polar substances such as water. At low concentrations of water vapor, molecular sieves have 6 to 10 times more adsorptive capacity than silica gel or activated aluminum oxide. Molecular sieves have found numerous applications in separating various impurities from the noble gases and from various organic compounds. Treatment of zeolites with potassium solutions leads to a decrease in the absorption of gases, whereas treatment with calcium solutions leads to absorption of even the larger gas molecules. The greater the amount of water in the silicate lattice, the greater is the absorptive capacity of the zeolite. Numerous applications of molecular sieves in removing H_2O, CO_2, CO, and H_2S from various gas streams are cited. At a pH of 5 to 11, ions such as Ag, Cu, Al, Zn, Sr, Ba, Ca, Co, Au, and K can be removed from solution. 117 references. (TTT)

2715 SEPARATION OF PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 852,151. Oct. 26, 1960.

Separation of plutonium from irradiated uranium by dissolution with HNO_3 and adsorption of plutonium, e.g., with bismuth phosphate precipitation, may be facilitated if the removal of excess HNO_3 and reduction of plutonium are carried out with one reagent, formic acid. For solutions of nitrate concentrations ~70%, one or more moles formic acid per mole HNO_3 should be added; whereas, for nitrate concentrations ~40%, 1.5 moles formic acid per mole HNO_3 are needed. The temperature should be 75 to 90°C in order to speed up the reaction and drive off the resulting gases. In this process the acidity should be reduced to below 0.5 N for adsorption of plutonium on a formaldehyde-sulfonated phenol resin (Amberlite IR-1) or bismuth phosphate. (D.L.C.)

2716 PROCESS FOR THE SEPARATION OF PLUTONIUM FROM NEUTRON IRRADIATED URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 852,501. Oct. 26, 1960.

Tracer amounts of plutonium may be separated from an acid solution of neutron-irradiated uranium by flowing the solution through a bed of a phospho-silicate complex of Zr, Ti, Hf, or Th; the fission products that may have been adsorbed may be eluted first and then the adsorbed plutonium eluted with 7 M HNO_3. The solution for treatment should be prepared by dissolving the irradiated uranium in HNO_3, removing as much as possible of the uranium with a suitable method, and reducing the plutonium. The complex may be prepared by acidifying a solution of a compound of Zr, Ti, Hf, or Th, a phosphate, and a silicate. The complex of Zr is best for adsorption of plutonium, although where H_2SO_4 is used, the complex should be of Ti which is resistant to H_2SO_4. Procedures are given for preparing Zr and Ti complexes and a mixture of these two. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

2717 (ARF-4132-6) POINT SOURCE EXPLOSION IN A SOLID. T. A. Zaker. Illinois Inst. of Tech., Chicago. Armour Research Foundation. Nov. 1959. 109p. Contract AT(11-1)-528. OTS.

An approximate theory of the growth of a point-source explosion in an infinite solid or liquid medium in the range of shock pressure below that required to induce a physical change of phase of the material and above pressures at which the wave propagation can be considered acoustic is presented. The analysis is based on the characterization of the shock-state locus for the material by a general form containing three constants related to the compressibility of the material. Both porous and nonporous solids are considered. Peak shock pressure and arrival-time data obtained by machine calculation as functions of shock radius are presented graphically and numerically in dimensionless form for several values of the compressibility constants involved. Methods of deducing values of the constants from compressibility data for particular materials are presented. The results are applicable to estimates of shock attenuation in a variety of blast absorbing or shielding materials. (auth)

2718 (BAW-1251) DESIGN AND CONSTRUCTION OF A FARADAY-TYPE ELECTROMAGNETIC PUMP. W. T. Hage. Babcock and Wilcox Co. Research Center, Alliance, Ohio. June 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 31p. Contract AT(30-1)-1940. OTS.

Mathematical analysis and optimization led to a design of a Faraday type electromagnetic pump with expected efficiencies of 20 to 50%, depending on the size of the pump. The pump was designed to pump liquid U–Bi at 10 gpm against a head of 100 psi and to operate at 1000°F in a radiation environment. (C.J.G.)

2719 (CERN-60-37) MESURE DE LA VITESSE DE POMPAGE EN ULTRA-VIDE. (Measurement of Pumping Rate in Ultra-vacuums). Michel Thierry. European Organization for Nuclear Research, Geneva. Sept. 15, 1960. 51p.

The defining characteristics of high-vacuum pumping (vacuum limit, poisoning time, and pumping speed) are discussed, and methods of measuring pumping rate are reviewed. A new method is proposed, and a study of it is described. The method involves the conductance of a diaphragm. (T.R.H.)

2720 (CF-60-3-56) STUDY OF OUTAGE EXPERIENCE WITH SELECTED BOILER AND TURBINE GENERATOR UNITS. M. L. Myers. Oak Ridge National Lab., Tenn. Mar. 31, 1960. 38p. OTS.

Analysis of unavailability periods for boilers and turbine generators at the Oak Ridge Gaseous Diffusion Plant (ORGDP) Power Station shows that only approximately five units out of 100 could operate for a year without a forced outage. Once an initial period of about 2500 hr is passed after startup, outages caused by troubles in the turbine and generator themselves are greatly reduced. Outages caused by the auxiliary equipment appear to be equally probable over the life of the plant. A comparison of these data from the ORGDP Power Station with data taken from six 1959 TVA operating reports revealed essentially the same incidence of forced shutdowns. This comparison was made with no attempt to distinguish between common header turbine

generators and unit-type boiler-turbine generators in either power system. All outages except standby periods were considered whether load reduction was required or not. (auth)

2721 (PWAC-298) DEVELOPMENT OF PUMP COMPONENTS FOR THE PRATT AND WHITNEY AIRCRAFT LIQUID METAL TURBOPUMP, TP-1. J. S. Murphy, R. S. Lombard, J. D. Sutherland, and J. Farquhar. Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn. Oct. 20, 1960. 186p. Contract AF33(600)-41233.

The tests conducted on TP-1 turbopump components consisted of mixed flow impeller tests, full scale TP-1 impeller and scroll-matching tests in water, cold hydrostatic tests of prototype TP-1 pump scroll, and evaluation of cermet type face seals. The water and hot liquid metal TP-1 mechanical center section test units are described. Mechanical and hydraulic performance is estimated for the pump from the results of the component tests. (See also PWAC-297.) (C.J.G.)

2722 (TID-7588(p.230-2)) THE CODE ASPECTS. E. M. Kloeblem. Linde Air Products Co., [New York].

Some of the background and history of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code are discussed. Application of the code to nuclear pressure vessel design is considered. (W.D.M.)

2723 (UCRL-6149-T) ISOSTATIC PRESSING AT LAWRENCE RADIATION LABORATORY. P. J. Crume. California. Univ., Livermore. Lawrence Radiation Lab. [1958?]. 11p. Contract W-7405-eng-48. OTS.

An over-all description of the equipment and operation of the isostatic press facility at Lawrence Radiation Laboratory is presented. The facility is designed for development of processes related primarily to pressing new materials. (J.R.D.)

2724 AN ULTRA-HIGH VACUUM SYSTEM USING AN OIL-DIFFUSION PUMP WITH A NON-REFRIGERATED ISOLATION TRAP. H. U. D. Wiesendanger and R. A. Pasternak (Stanford Research Inst., Menlo Park, Calif.). Experientia 16, 467-8(1960). (In English)

Ultrahigh vacuums with a basic pressure of less than 5×10^{-10} mm Hg were routinely produced and maintained for several months by means of an oil diffusion pump. An isolation trap charged with activated alumina of large cross section is placed between pump and glass system. The back flow of oil vapors into the experimental apparatus was completely prevented without cooling. (tr-auth)

2725 TRANSIENT TEMPERATURES AND THERMAL STRESSES IN HOLLOW CYLINDERS DUE TO HEAT GENERATION. John E. Schmidt (Westinghouse Electric Corp., Pittsburgh) and George Sonnemann. J. Heat Transfer 82, 273-8(1960) Nov.

A general solution for transient temperatures and thermal stress was obtained for a right circular cylinder with internal heat generation varying exponentially with the radius by use of Hankel transforms. Curves for the maximum thermal stresses are presented for diameter ratios up to 1.2 and for a variety of internal heat-generation rates for internal heat-generation transients with both cylinder walls maintained at zero reference temperature at all times. (auth)

2726 THIN VACUUM-DENSE WALLS. L. F. Kondrashev, S. N. Rybin, N. I. Sokolov, and N. N. Khaldin. Pribory i Tekh. Ekspt. No. 4, 102-5(1960) July-Aug. (In Russian)

The construction of thin high-vacuum walls used in various devices for studying nuclear reactions in a cyclotron is described. (tr-auth)

2727 DESIGN OF A DISTRIBUTED CONTROL SYSTEM. Olegh Bilous (Centre d'Études Nucléaires, Saclay, France). 15p. of "Proceedings [of the] NYU-IBM Symposium on Digital Computing in the Chemical and Petrochemical Industries, May 1958." (CEA-1250)

A digital computer is used to evaluate various pressure control systems for a gaseous diffusion cascade. This is an example of a distributed feedback control system. A brief discussion is given of similar cases of distributed or stagewise control systems, which may occur in multiple temperature control of chemical processes. (auth)

2728 IMPROVEMENTS IN OR RELATING TO VALVES FOR USE WITH RADIOACTIVE FLUIDS. (to Atomic Energy of Canada Ltd.). British Patent 851,485. Oct. 19, 1960.

A valve was invented that has a dependable positive stem seal, is corrosion-resistant, and has a leakage rate on the order of one drop per 50 years. The valve uses a spring-loaded packing in combination with an electropolished valve stem. A drawing of the valve is included. (D.L.C.)

2729 IMPROVEMENTS RELATING TO PIPE COUPLINGS. Dennis Reginald Clark. (to A. E. I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 851,889. Oct. 19, 1960.

A method is described for coupling two pipe sections so that the coupling and uncoupling can be controlled from a remote point (e.g., changing reactor control-rod actuators while the reactor is under pressure). The pipe coupling is accomplished by means of a flange on one pipe section abutting against a shoulder on the other pipe section; a pressure-tight sleeve is clamped around the coupling to enable actuator uncoupling. (D.L.C.)

2730 GREASES. Arthur Leslie Morris and Peter Joseph Vermont James Agius (to Esso Research and Engineering Co.). British Patent 853,751. Nov. 9, 1960.

Radiation-resistant greases stable to heat and hot CO_2 and suitable for lubrication in CO_2-cooled reactors can be made by mixing mineral oil with carbon black and 5 to 50% of a hydrocarbon polymer having a molecular weight up to 10,000. Such a polymer may be polyisobutylene, polyethylene, polypropylene, or polystyrene. Polymers of lower molecular weight (500 to 2000) are preferred for use at high neutron fluxes or temperatures, and the amount of polymer added should be such as to increase the viscosity of the base oil to 40 to 70 centistokes at 210°F. The polymer may also be mixed with a copolymer, e.g., butyl rubber. The oil should contain as little sulfur as possible, and an antioxidant should be used, e.g., phenylnaphthylamine. Experiments run on some grease compositions made in the above way show that oil leakage is low at high temperatures and that their physical properties are not changed appreciably after irradiations up to 10^9 rad. (D.L.C.)

Heat Transfer and Fluid Flow

2731 (CEA-1422) TRANSFERT DE CHALEUR PAR LIQUIDES ENTRAÎNÉS DANS UN ÉCOULEMENT GAZEUX TURBULENT. (Heat Transfer by Liquids in Suspension in a Turbulent Gas Stream). P. Perroud and A. de la Harpe. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 62p.

The introduction of a small volume of liquid into a

turbulent gas stream used as cooling agent considerably improves the heat-transfer coefficient of the gas. When the turbulent regime is established in a cylindrical tube, two types of flow are observed, depending on whether the liquid wets or does not wet the wall. In the first case, an annular liquid film on the wall and droplets in suspension in the gas stream are formed. In the second case, a fog of droplets is formed without any liquid film on the wall. Experiments were performed with the following mixtures: water–hydrogen, water–nitrogen, ethanol–nitrogen (wetting liquids) introduced into a stainless-steel tube of 4-mm ID, electrically heated on 320 mm of the length. The gas flow rate (Reynolds number to 50,000), the ratio of liquid-flow rate to gas flow rate (to 15), the pressure (to 10 kg/cm^2), the temperature (to the boiling point) and the heat flux (to 250 w/cm^2) were varied. (auth)

2732 (CEA-1430) ÉTUDE THÉORIQUE DE L'INFLUENCE SUR LA TEMPERATURE DE SURFACE D'UNE PERTURBATION GÉOMETRIQUE DE LA PAROI D'UN CANAL CHAUFFÉ ÉLECTRIQUEMENT. (Theoretical Study of the Influence of Surface Temperature of a Geometrical Perturbation of Wall of an Electrically Heated Channel). R. Gerber. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 27p.

In experiments on forced-convection heat transfer in an electrically heated channel, the temperature of the channel face in contact with the fluid is calculated from the measured temperature of the isolated face. A process for measuring this temperature leads to the study of the theoretical influence of a local perturbation of the wall thickness on the temperature distribution in this wall. Various problems at the limits, posed by this question of measurement, are dealt with. (auth)

2733 (GAT-T-679) TWO-PHASE FLOW RATES AND PRESSURE DROPS IN CURVED TUBES. H. L. Foltz. Goodyear Atomic Corp., Portsmouth, Ohio. Jan. 8, 1960. 18p. Contract AT(33-2)-1. OTS.

Two-phase flow rates and pressure drops were measured in an electrically heated natural-circulation loop containing two curved copper tubes. The radii of curvature of the two tubes were 1.5 and 3 ft. The flow rates through both tubes first increased, reached a maximum, and then decreased as the heat flux was increased. The flow rate through the long tube reached a maximum at a heat flux of 4500 Btu/hr-ft^2. The flow rate through the short tube reached a maximum at a heat flux of 10,000 Btu/hr-ft^2. Equations developed from a mechanical energy balance were used to calculate two-phase pressure drops. These equations assumed fog flow, or no slip, and no subcooled boiling. Pressure-drop curves, representing different flow rates, were drawn for each tube. The calculated pressure drops range from 1 to 38% lower than the measured values because of the effect of slip and subcooled boiling. (auth)

2734 (LAMS-2365) WAT: A NUMERICAL METHOD FOR TWO-DIMENSIONAL UNSTEADY FLUID FLOW. Walter B. Goad. Los Alamos Scientific Lab., N. Mex. Sept. 20, 1960. 22p. Contract W-7405-eng-36. OTS.

A method is described in which difference equations are derived by application of the principle of virtual work to a particular fluid model. Some other innovations involve the viscous pressure, different time intervals for different points, and a method of handling the collision of free interfaces. (auth)

2735 (NGTE-R-241) AN EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER FROM THE INSIDE SURFACE OF A HOT SMOOTH TUBE TO AIR, HELIUM AND CARBON DIOXIDE. J. F. Barnes. Gt. Brit. National Gas Turbine Establishment, Farnborough, Hants, England. Mar. 1960. 52p. (AD-237862).

Experimental values are given of Nusselt number as a function of Reynolds number and surface/gas temperature ratio for three gases, air, helium, and carbon dioxide, and show the effects of radial variations of fluid properties with temperature. The conditions under which the experiments were performed were fully developed velocity and temperature profiles and subsonic turbulent flow. These conditions are typical of those encountered in the cooling passages of a nuclear reactor or turbine blades. The experimental results are presented in a form suitable for use in design work and are compared with existing experimental and theoretical data. (auth)

2736 (NP-9275) HEAT SINKS; MATERIALS. Maureen Pearcy, comp. Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif. Aug. 17, 1960. 32p. (SB-60-29). OTS.

A bibliography of 88 references from report and published literature on thermal conductivities of materials for use in heat-sink systems related to space and reentry vehicles is presented. The references are arranged alphabetically by author. The period covered is 1949–60. (J.R.D.)

2737 (WAPD-BT-20(p.61-72)) CONSERVATION LAWS IN ONE-DIMENSIONAL HYDRODYNAMICS. J. E. Meyer. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

Equations expressing the laws of conservation of mass, momentum, and energy are required for the study of hydrodynamics in reactor coolant channels. This article contains a discussion of these equations with an outline of assumptions involved in their derivations. Special emphasis is placed on developing the macroscopic quantities needed to describe the two-phase slip flow. (auth)

2738 (WAPD-T-934) AXIAL VARIATION OF TRANSIENT TEMPERATURES IN AN INFINITE HOLLOW CYLINDER. (Thesis). Rudolph Joseph Scavuzzo, Jr. Pittsburgh. Univ. 1959. 48p. OTS.

A solution for the transient-temperature distribution in a hollow tube, infinite in length, was derived. The temperature distribution is assumed to be axially symmetric with variations in the radial and axial directions. Transformation methods were used to solve the partial differential equation of heat conduction. Initially the pipe is assumed to be at zero temperature. At time greater than zero, the temperature along the inner wall of the pipe is assumed to be a function of the axial dimension. The outer wall was kept at zero. The temperature along the inner surface was defined to be a constant, T_0, over a certain sector of the pipe. Outside this region the temperature is also kept at zero. Numerical calculations are made for a pipe with a ratio of outside diameter to inside diameter of 2. (auth)

2739 HYDRAULIC RESISTANCE TO THE FLOW OF A LIQUID ALONG A BUNDLE OF RODS. V. I. Subbotin, P. A. Ushakov, and B. N. Gabrianovich. Atomnaya Energ. 9, 308-10(1960) Oct. (In Russian)

Resistance to streamline flow along rod bundles with dense (S/d = 1.0) and semi-dense (S/d = 1.13) rod packing was studied. The bundles consisted of 7 rods and 12 spacers. The spacers were used to secure a uniform distribution of liquid along the bundle cross sections. The experiments were carried out in water. The coefficient of friction and data on dense bundle packing are plotted and compared with previously published work. Test results

indicate that utilization of hydraulic diameters as characteristic values in generalizing data on bunch resistance to flow does not lead to an automatic evaluation of rod spacing in the bundle. The presented data are recommended for practical calculations of bundle resistance to axial liquid streamlining. (R.V.J.)

2740 HEAT TRANSFER TO MERCURY FLOWING TURBULENTLY IN AN ANNULUS. V. I. Subbotin, P. A. Ushakov, and I. P. Sviridenko. Atomnaya Energ. 9, 310-12 (1960) Oct. (In Russian)

The experimental arrangements $l = 1000$ mm, $d_2/d_1 = 1.05$, aperture width = 1 mm; and $l = 400$ mm, $d_2/d_1 = 1.09$, aperture width = 2 mm were prepared from carbon steel. Surface temperatures were measured with 12 0.2-mm diameter thermocouples. The experiments were carried out at mercury flow rates of 0.3 to 3.8 m/sec, temperatures of 30 to 40°C, and thermal fluxes q from 25×10^3 to 75×10^3 kcal/m^2/hr. With two-side heating of the annuli, $d_2/d_1 < 1.09$ and equal thermal flows on both surfaces, heat transfer to mercury is about two-fold higher than in one-side heating. In a narrow annular clearance, in the absence of preliminary hydrodynamic stabilization, the region of thermal stabilization is $\sim 30 d_r$. Changes in the annular clearance geometry influence the heat transfer. (R.V.J.)

2741 ANALYSIS OF TRACER EXPERIMENTS: IV. THE KINETICS OF GENERAL N COMPARTMENT SYSTEMS. H. E. Hart (City Coll., New York and Montefiore Hospital, New York). Bull. Math. Biophys. 22, 41-52(1960).

The methods of Sheppard and Householder are employed in studying the kinetics of general N compartment systems. It is shown that the nature of the transfer processes occurring in fluid-flow systems and the chemical processes occurring in quadratic systems and in catalyzed quadratic systems can in principle be completely determined for all polynomial dependencies. Systems involving three-body and higher-order interactions can be completely solved, only if supplementary information is available. (auth)

2742 TWO-PHASE FLOW RATES AND PRESSURE DROPS IN PARALLEL TUBES. H. L. Foltz and R. G. Murray (Goodyear Atomic Corp., Portsmouth, Ohio). Chem. Eng. Progr. 56, Symposium Ser. No. 30, 83-94 (1960).

Two-phase Freon-114 flow rates and pressure drops were measured in an electrically heated natural-circulation loop containing two 4- and two 8-ft lengths of vertical brass pipes. The flow rates through the 8-ft pipes increased with an increase in heat flux, reached a maximum at 3200 Btu/hr/sq ft, and then decreased as the heat flux was increased. The maximum obtainable heat flux, for both long and short pipes, was limited to 14,000 Btu/hr/sq ft because of the limitations on the electrical heaters. The flow rates through the 4-ft pipes continued to increase with increases in heat flux up to the maximum. An equation which assumed fog flow, or no slip, was developed from a mechanical energy balance to calculate two-phase pressure drops. This equation, containing only the independent variables of heat input, flow rate, and pipe length, was programed for an analogue computer, and a series of pressure-drop curves, representing different flow rates, as a function of heat input was drawn for each pipe length. The calculated pressure drops were approximately 25% lower than the measured values, due primarily to the effect of slip and subcooling at the inlet end of each tube. (auth)

2743 A VARIABLE DENSITY SINGLE-FLUID MODEL FOR TWO-PHASE FLOW WITH PARTICULAR REFERENCE TO STEAM–WATER FLOW. S. G. Bankoff (Northwestern Univ., Evanston, Ill.). J. Heat Transfer 82, 265-72(1960) Nov.

A physical model is proposed for the bubble-flow regime of liquid–gas flow which is in good agreement with the important features of the process. In this model it is conceived that the mixture flows as a suspension of bubbles in the liquid, where radial gradients exist in the concentration of bubbles. The bubble concentration is assumed maximum at the center of the pipe, decreasing monotonically in a radial direction, and vanishing at the pipe wall. An important concept introduced is that the gas and liquid have the same velocity at any radial position. The flow parameter assumes different forms for flow in circular pipes and for flow between two flat plates. (M.C.G.)

2744 THERMAL-CONTACT RESISTANCE IN FINNED TUBING. Karl A. Gardner and T. C. Carnavos (Griscom-Russell Co., Massillon, Ohio). J. Heat Transfer 82, 279-93(1960) Nov.

Interference-fit finned tubes depend for their heat-transfer capability upon a contact pressure between fin and tube. The bond resistance under such conditions is relatively small compared to the other resistances in the heat-flow path. At elevated temperatures, however, differential thermal expansion between fins and tubes completely relaxes the contact pressure and introduces an additional gap resistance; this may become a significant part of the total resistance to heat transfer. A theoretical method for predicting the gap resistance is derived in terms of the fin and tube dimensions, their physical properties, the fluid temperatures and heat-transfer coefficients, and the initial contact pressure. Test data on five finned-tube units representing embedded, tension-wound, and muff-type fins are given in graphical and tabular form. Very good agreement is found between theory and test in two of the interference-fit units. The other two show only fair agreement. (auth)

2745 HEAT TRANSFER AND EFFECTIVENESS FOR A TURBULENT BOUNDARY LAYER WITH TANGENTIAL FLUID INJECTION. R. A. Seban (Univ. of California, Berkeley). J. Heat Transfer 82, 303-12(1960) Nov.

Experimental results are presented for the effectiveness and heat-transfer coefficient of a film cooling system in which air was used both for the film and for the free-stream fluids. Injection occurred at a single tangential slot near the leading edge of the plate, and the slot size was varied. All flows were turbulent, and the injection velocities covered a range from much less to much greater than the free-stream velocity. Correlations were realized for both the effectiveness and the heat-transfer coefficient and, as in past experience with such systems, separate specifications were needed for injection velocities greater and less than the free-stream velocity. (auth)

2746 HEAT TRANSFER TO LIQUID METALS WITH VARIABLE PROPERTIES. R. Viskanta and Y. S. Touloukian (Purdue Univ., Lafayette, Ind.). J. Heat Transfer 82, 333-40(1960) Nov.

The problem of heat transfer to liquid metals with variable physical properties for the case of fully developed turbulent flow in cylindrical tubes of constant diameter was studied. The fluid under consideration was heated or cooled by a constant and uniform heat flux at the wall. The similarity theory between momentum and heat transfer was used. The von Karman universal velocity profile was used to solve the differential equations for turbulent flow with heat transfer for the Prandtl number and the kinematic viscosity, each having five different sets of temperature-dependent exponents of a_1 and a_2. Calculated temperature

distributions and mixing-cup temperatures, as well as relations between Nusselt versus Peclet numbers, are presented for the cases of heat addition, heat extraction, and the nonvariable-property case. (auth)

2747 A SUMMARY OF EXPERIMENTS ON TURBULENT HEAT TRANSFER FROM A NONISOTHERMAL FLAT PLATE. W. C. Reynolds, W. M. Kays, and S. J. Kline (Stanford Univ., Calif.). J. Heat Transfer 82, 341-8(1960) Nov.

The results of an extensive experimental investigation of heat transfer to a turbulent incompressible boundary layer from a nonisothermal flat plate are summarized. Data presented extend the range of low-Mach-number confirmation of the von Karman analogy to Reynolds numbers of 4×10^6 for an isothermal plate. Data for a step wall-temperature distribution confirm experimentally the preferable expression for this important superposition kernel case. Data from a variety of other examples confirm the use of the superposition theories to predict heat transfer from nonisothermal surfaces. (auth)

2748 AN EXPERIMENTAL STUDY OF THE EFFECTS OF NONUNIFORM WALL TEMPERATURE ON HEAT TRANSFER IN LAMINAR AND TURBULENT AXISYMMETRIC FLOW ALONG A CYLINDER. R. Eichhorn (Princeton Univ., N. J.), E. R. G. Eckert, and A. D. Anderson. J. Heat Transfer 82, 349-59(1960) Nov.

Measurements of both the hydrodynamic and thermal characteristics of flow over an axial cylinder at subsonic speeds are reported. It was found that the boundary layer along an axial cylinder tends to become asymmetrical as it approaches the transition point. This asymmetry vanishes again in turbulent flow. For both laminar and turbulent flow, the average boundary-layer growth could be predicted by the standard flat-plate relationships, and simple methods were deduced for determining the effective hydrodynamic length of the boundary layers. Local and total heat-transfer measurements were made with both laminar and turbulent flow for various unheated starting lengths followed by linearly increasing wall temperatures. For laminar flow, agreement with theory was obtained, this agreement being improved by the Seban and Bond cylindrical curvature correction. The turbulent-flow results indicated preference for the theory of Seban. Isothermal equations represent turbulent heat transfer within approximately 20% when the wall-temperature variations are not too abrupt. (auth)

2749 THERMAL RADIATION FROM A CYLINDRICAL ENCLOSURE WITH SPECIFIED WALL HEAT FLUX. C. M. Usiskin and R. Siegel (National Aeronautics and Space Administration, Lewis Research Center, Cleveland). J. Heat Transfer 82, 369-74(1960) Nov.

Thermal radiation was considered from the inside surface of a heated cylindrical enclosure. A specified heat input was imposed at the enclosure wall and the surface temperature distribution was determined. The analysis considered both black and diffuse gray-body radiation and obtained a simple relation between the two. The energy equation, a linear integral equation, was solved by three methods: use of a separable kernel, numerical integration, and variational methods. (auth)

2750 APPLICATION OF VARIATIONAL METHODS TO RADIATION HEAT-TRANSFER CALCULATIONS. E. M. Sparrow (National Aeronautics and Space Administration, Lewis Research Center, Cleveland). J. Heat Transfer 82, 375-80(1960) Nov.

A variational method is presented for solving a class of integral equations which arise in radiation heat-transfer problems. First, to demonstrate the formulation of radiation problems in terms of integral equations, consideration is given to a system consisting of two nonblack, finite, parallel plates. After a general description of the variational method, its use is illustrated by application to the parallel-plate system. Comparisons are made which show very good agreement with exact solutions. (auth)

2751 TEMPERATURE DISTRIBUTION AND HEAT-TRANSFER RESULTS FOR AN INTERNALLY COOLED, HEAT-GENERATING SOLID. E. M. Sparrow (Univ. of Minnesota, Minneapolis). J. Heat Transfer 82, 389-92 (1960) Nov.

An investigation was made of the temperature distribution and heat transfer in heat-generating solids which are internally cooled by circular flow passages. Under the conditions of hydrodynamically and thermally fully developed flow and uniform internal heat generation in the solid, the temperature rises linearly in the direction of fluid flow. It was found that with increased spacing of passages, the temperature field about any passage is less and is less influenced by neighboring passages. The local heat flux was essentially uniform around the periphery of the cooling passage. (M.C.G.)

2752 THE MECHANISM OF SOUND FIELD EFFECTS ON HEAT TRANSFER. J. P. Holman (Southern Methodist Univ., Dallas). J. Heat Transfer 82, 393-6(1960) Nov.

When a strong sound field is impressed on the free convection boundary-layer flow about a horizontal heated cylinder, the heat transfer rates may be increased by as much as 300%. This effect is explained in terms of the interaction of acoustical streaming with the boundary-layer flow. It was found that when the amplitude of oscillation of the sound field was raised above a certain critical value the streaming patterns became intensified and deviated from theory. Several reasons are given for the increase in heat transfer above this critical value. (M.C.G.)

2753 HEAT TRANSMISSION WITH BOILING. G. S. Emmerson (Univ. of Western Ontario, Can.). Nuclear Eng. 5, 493-500(1960) Nov.

A review and discussion are presented of the rapidly growing store of knowledge of boiling heat transfer, with special reference to reactor applications. The regimes of boiling heat transfer are illustrated by the "Boiling Curve," which was obtained from experiments on electrically-heated wire immersed horizontally in a water bath. No correlation has been established to govern the boiling curve over all regimes although separate correlations were developed, theoretically and empirically, for convection, nucleate boiling, and film boiling with varying limitations. For nucleate boiling it seems simple enough to state that the remarkable increase in heat flux is caused by the agitation of the vapor bubbles, and although this is a satisfactory explanation, it has not proved sufficient in itself for the development of a theory. The transition from nucleate boiling to film boiling and burn-out takes place by way of the Departure from Nucleate Boiling (DNB) point, and occurs very rapidly. For this reason, the DNB flux is regarded as the burn-out flux for reactor design purposes. The influences of pressure, local bulk subcooling or quality, channel geometry, and mass velocity on burn-out are discussed. Equations are tabulated for burn-out correlations; their range of applications, geometry, and pertinent remarks are given. When the boiling and burn-out mechanisms are more fully understood and expressed mathematically, the proper interpre-

tation of loop test data will be facilitated, and reliable correlation will be made possible. (B.O.G.)

2754 ZERO GRAVITY BOILING AND CONDENSING. Lloyd M. Hedgepeth (Wright-Patterson Air Force Base, Dayton, Ohio). Paper No. 1322-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 15p.

A brief history is presented of the zero-gravity boiling and condensing test effort at WADD. This history is then brought up to date; and, in all cases, an account of the phenomenon occurring during the tests is given along with a possible explanation. Significant observations from the latest flights also are included along with preliminary plans for future tests. (auth)

Instrumentation

2755 (AECL-801) PROCEEDINGS OF THE SIXTH TRIPARTITE INSTRUMENTATION CONFERENCE HELD AT CHALK RIVER, ONTARIO, APRIL 20-24, 1959. PART 1: REACTOR INSTRUMENTS. J. E. Woolston and S. J. Townsend. Atomic Energy of Canada Ltd., Chalk River, Ont. Apr. 1960. 224p. AECL.

Thirty-one papers on reactor instrumentation are given along with a summary of the discussion which followed each presentation. Lists of the participants and abbreviations used in the proceedings are given. Separate abstracts were prepared for 27 papers. (W.D.M.)

2756 (AECL-801(p.5-18)) DEVELOPMENT OF REACTOR INSTRUMENTATION AT THE MTR. K. A. McCollom. Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

The instrument development for support of reactor operations at the Materials Testing Reactor (MTR) is discussed in terms of instrumentation for low-power reactors, instrumentation for the testing reactors, and MTR hot-cell instrumentation. (W.D.M.)

2757 (AECL-801(p.19-29)) INSTRUMENTATION FOR SAFETY: CONTROL AND OPERATION OF A HANFORD REACTOR. A. G. Dunbar. General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A reactor-instrumentation summary is presented in two parts: nuclear instrumentation and associated-process instrumentation. The discussion on nuclear instrumentation includes subcritical and start-up ranges, intermediate-level, equilibrium-power, and equilibrium-flux-distribution systems. The discussion on the associated-process instrumentation includes coolant-flow, -temperature and -activity monitoring. Detailed system descriptions are presented for the subcritical neutron-flux monitor and the coolant-activity monitoring system. The subcritical system monitors the reactor during shutdown conditions and through the reactor start-up. The range of the subcritical system extends from subcritical through critical and into the intermediate neutron-flux level. The coolant-activity monitoring system detects the occurrence of in-pile fuel-element failures. (auth)

2758 (AECL-801(p.37-41)) RECENT DEVELOPMENTS IN THE INFRA-RED ANALYSIS OF HEAVY WATER. J. G. Bayly and W. H. Stevens. Atomic Energy of Canada Ltd., Chalk River, Ont.

New infrared methods for analyzing heavy water based on absorption spectra are discussed. Principal features of Tri-non and Bichromator type analyzers are outlined. (W.D.M.)

2759 (AECL-801(p.42-54)) A NUCLEAR-REACTOR TRANSFER-FUNCTION ANALYZER. D. Harrison. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

The sinusoidal method, when used to measure the transfer function between reactivity and neutron flux, consists in causing a sinusoidal modulation of reactivity and observing how the resultant neutron-flux response varies in amplitude and phase relative to this reactivity modulation over a wide range of frequencies. Necessary equipment consists of a reactor oscillator and analyzing instrumentation. Equipment developed at Harwell is discussed. (W.D.M.)

2760 (AECL-801(p.55-60)) INTERNAL FLUX MEASUREMENT. A. C. Lapsley and R. R. Ingham. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

Three flux monitors, developed for measuring neutron and γ flux, are described. The neutron monitor and one of the γ monitors utilize the heat generated in appropriate radiation-absorbing materials as a measure of flux. Thermocouples measure the resulting ΔT values. The other γ monitor is an ion chamber. (W.D.M.)

2761 (AECL-801(p.61-6)) NEW RUPTURE DETECTORS. R. G. Smith, W. R. Kritz, A. C. Lapsley, and C. R Hutchins. Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C. and Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

New rupture detectors in use or in testing stages at the Savannah River Plant detect the fission products released by a failing fuel element in either the heavy-water process stream or the helium-blanket gas. The low-energy-γ monitor and the gas-chromatograph rupture monitor are described. (W.D.M.)

2762 (AECL-801(p.67-70)) DESIGN CONCEPTS OF DIGITAL TEMPERATURE MONITOR. R. W. Leep and M. H. Goosey. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

A problem arises in monitoring temperatures under process conditions; essentially continuous monitoring of a large number of grounded thermocouples is required. Extreme reliability of the monitor is required both for the protection of the process and for the prevention of costly interruptions of the process due to spurious alarms. A monitor is proposed which uses the newer switch developments and digital techniques. It provides a complete scan of the points in 0.1 sec and gives an alarm indication in 0.2 sec. (W.D.M.)

2763 (AECL-801(p.71-2)) REACTOR FLUX MONITORS. R. V. Studley. Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.

A highly reliable alarm circuit, developed at Savannah River to supply a scram signal in case of excessive neutron flux in a reactor, is illustrated. Switching transients were eliminated so that range changes could be made without bypassing reactor alarm circuits. The instrument is relatively insensitive to mechanical shock or normal line-voltage fluctuations. (W.D.M.)

2764 (AECL-801(p.73-6)) DETECTION OF D_2O LEAKAGE IN HEAT EXCHANGERS. G. H. Gruber. Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.

Operating techniques and scintillators were developed for the use of a "Tri-Carb" scintillation counter as a sensitive indicator of D_2O leakage into the light-water side of reactor heat exchangers. Neutron capture by deuterium

causes a tritium buildup in the coolant, and small leaks of D_2O can be detected by monitoring the light-water effluent for tritium activity. The sensitivity was sufficient to detect 0.05 to 0.1 $\mu c/l$ of tritium in water. Counting method, results, scintillator testing, and instrument settings are discussed. (W.D.M.)

2765 (AECL-801(p.77-83)) ANALYSIS OF THE NON-LINEAR BEHAVIOUR OF SEMICONDUCTOR JUNCTIONS AND ITS APPLICATIONS IN NUCLEONICS. F. S. Goulding, C. G. Lennox, and L. B. Robinson. Atomic Energy of Canada Ltd., Chalk River, Ont.

Equations governing the behavior of junction diodes are discussed. The effects of temperature on voltage drop and incremental impedance, diodes as logarithmic elements, and balanced diode and transistor arrangements are considered. (W.D.M.)

2766 (AECL-801(p.84-8)) SEMICONDUCTORS IN DC APPLICATIONS. C. G. Lennox. Atomic Energy of Canada Ltd., Chalk River, Ont.

Current amplifier applications include reading signals up to 50 μA from ionization chambers; switching and amplifying milliwatt d-c signals, especially in cases where considerable data handling is desirable; and use in voltage and current regulators having stabilities from 1% extending down to 0.01% where high-accuracy references are required. Direct-current coupling, a-c techniques, diode modulators, and transistor modulators are discussed. (W.D.M.)

2767 (AECL-801(p.89-105)) THE OPERATION OF IONIZATION CHAMBERS FROM ALTERNATING POLARIZING SUPPLIES. D. Harrison. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A study of the use of ionization chambers with alternating polarizing supplies as a means of measuring ionizing radiations, particularly for flux measurements in nuclear reactors, is described. It is shown that operation in this manner is potentially capable of giving the measuring circuit a high degree of reliability, that it can provide a simple self-monitoring facility, and that it should result in simplification of the circuit requirements. The method may also have advantages in the measurement of ionizing radiations of very low intensity, but this feature has not yet been fully investigated. The effects of varying the amplitude and frequency of the applied voltage, of using different gases in the ionizing volume, and of changing gas pressures were studied experimentally. Differences in behavior between BF_3 and boron coatings (natural and enriched) were noted and the electrical properties of these coatings were examined. Possible circuit arrangements for a shut-down amplifier channel for a nuclear reactor are discussed. (auth)

2768 (AECL-801(p.106-10)) A PHASE-SENSITIVE RELAY AND INDICATING INSTRUMENT. D. Harrison. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

Phase-sensitive circuits provide an output that indicates, relative to some reference, the amplitude and phase of an alternating input. Such circuits find application in reactor instrumentation where a-c signals are to be detected in which the sense of the signal must be preserved and where the fail-to-safety character and discrimination against spurious signals are important. Development of phase-sensitive relays and indicating instruments is discussed. (W.D.M.)

2769 (AECL-801(p.111-30)) EXPERIENCE WITH THE NRX AND NRU CONTROL SYSTEMS. A. Pearson and C. G. Lennox. Atomic Energy of Canada Ltd., Chalk River, Ont.

The control achieved by the automatic systems on the NRX and NRU reactors is considered in detail. Some of the problems encountered with each reactor are discussed and examples are given of control-element failures in the triplicated systems. (W.D.M.)

2770 (AECL-801(p.131-48)) TEMPERATURE INFORMATION PROCESSING EQUIPMENT. K. Sandiford. United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

Equipment is described which will monitor the output of 600 thermocouples about equally divided between the graphite moderator and fuel elements of a thermal reactor. The equipment scans all the thermocouples at high speed and presents this information in easily assimilated form to the pile operator. An alarm indication is given in the control room when the temperature registered by any thermocouple exceeds a predetermined safe figure or when the rate of increase of temperature in any part of the reactor departs from normal. (W.D.M.)

2771 (AECL-801(p.149-52)) THE DIXIE GAUGE. L. E. Goodwin. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

The Dixie Gage is an instrument that uses linear variable differential transformers as the "sensing" elements to measure the outside and inside diameters of extended tubes. Such transformers, when connected in a null-balance a-c circuit and supplied with amplification, are capable of detecting variations in transformer armature movement of less than 0.001 in. The instrument is composed of two separate servo readout systems. (W.D.M.)

2772 (AECL-801(p.153-6)) ZIRCONIUM CLADDING TESTER. A. P. Holt. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

The tester is an eddy-current instrument designed to measure the thickness of a zirconium or Zircaloy cladding on a natural-uranium fuel element. A small probe is placed on the cladding and the thickness is indicated on a panel meter. The instrument can detect a change of 0.00025 in. in the thickness range from 0.005 to 0.025 in. (W.D.M.)

2773 (AECL-801(p.157-9)) EDDY-CURRENT VECTORSCOPE AND ITS APPLICATION. A. P. Holt. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

The vectorscope is an instrument on which the impedance of a probe coil can be displayed. The frequency can be varied between 1 and 20 kc so as to determine the effect of the variables to be measured on the impedance of various probe coils. The coil is placed in one leg of an a-c bridge that is driven by an oscillator, and the bridge is adjusted to balance for a given condition. The output from the bridge is amplified, split, and fed to oscilloscope plates. (W.D.M.)

2774 (AECL-801(p.160-5)) DESIGN AND EXPERIMENTAL EVALUATION OF ELECTROMAGNETS FOR RESEARCH REACTORS. C. Michelson. Oak Ridge National Lab., Tenn.

Many research reactors use electromagnets in their safety systems to hold scram rods in the cocked position during normal operation. A study was made of the parameters affecting magnet performance, and the results were used to design a fast-acting magnet for a pool-type research reactor. In such a reactor, the safety rod is attached to the magnet armature. Performance characteristics for the magnet are given. (W.D.M.)

2775 (AECL-801(p.166-9)) A VARIABLE FUNCTION DELAY FOR ANALOG COMPUTERS. R. A. Dandl and R. S. Stone. Oak Ridge National Lab., Tenn.

Analysis of power-reactor problems on the analog computer usually requires the simulation of transport lags. A compact and relatively simple transport-lag device was designed which utilizes a synchronously switched bank of condensers. This design requires only one operational amplifier per lag and permits excellent response to signals with periods as short as half the delay time. Square waves are reproduced as square waves with any small error appearing only as an offset in the delay time. Delay time is easily changed by altering brush spacing and/or motor speed. Four of these devices were built and operated successfully as transport lags in simulated reactor systems for a period of four years. (auth)

2776 (AECL-801(p.170-4)) IN-LINE GAMMA MONITOR. E. C. Wingfield. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

The in-line γ monitor is an instrument that is designed to measure the gross γ activity of a solution contained in a closed sample cell. The detecting element is a NaI(Tl) scintillation crystal optically coupled to a photomultiplier tube. The current from the photomultiplier is measured by a simple one-tube electrometer circuit. The system is illustrated and the performance is discussed. (W.D.M.)

2777 (AECL-801(p.175-8)) IN-LINE GAMMA ABSORPTOMETER. D. H. Thurnau and T. R. Herold. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

An in-line γ absorptometer was developed to continuously measure the concentration of heavy-metal salts in process solutions. The concentration measurement is made by determining the extent to which the intensity of a beam of γ rays is attenuated in passing through the solution. The dual-beam system automatically compensates for background radiation intensities up to approximately 25 mr/hr. (W.D.M.)

2778 (AECL-801(p.179-83)) IN-LINE CONDUCTIVITY INSTRUMENTS. D. W. Colvin. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

A conductivity meter was developed as a general-purpose instrument for measuring the concentration of conductive chemicals in process streams. The conductance of the solution is measured, and the result is indicated on a recorder which is calibrated in terms of the chemical concentration being measured. The instrument consists of a sample cell, a measuring circuit, and a recorder. (W.D.M.)

2779 (AECL-801(p.184-7)) IN-LINE COLORIMETER. D. W. Colvin. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

A colorimeter designed specifically to monitor the uranium concentration of aqueous mixer-settler solutions is described. The solutions in general contain uranyl nitrate and various concentrations of other chemicals. The sample stream is obtained from the mixer-settler by an air-lift sampler. The colorimeter is a dual-beam instrument in which the ratio of measuring and reference signals is taken. (W.D.M.)

2780 (AECL-801(p.188-91)) IN-LINE NEUTRON MONITOR. A. C. Lapsley and L. E. Weisner, Jr. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

A neutron monitor developed for in-line measurements in a separations process is described. The BF_3 counter detector is coupled to a transistorized amplifier with a 100-ft length of cable. The BF_3 counters can be positioned remotely by pushing the polyethylene-stiffened cable through conduits. The circuit performs satisfactorily with both BF_3 and fission counters as the neutron detector. (W.D.M.)

2781 (AECL-801(p.192-205)) CHALK RIVER EXPERIENCE ON ACTIVITY MONITORS FOR BURST-SLUG DETECTION. J. F. Palmer. Atomic Energy of Canada Ltd., Chalk River, Ont.

The bulk of the experience at Chalk River on burst-slug detection has been with failures of natural-uranium fuel having unbonded aluminum sheaths. The activity monitors used to detect sheath failures have been mainly delayed-neutron and gaseous-fission-product monitors. The monitor installation in the NRU reactor and the more difficult problems associated with detection of sheath failures in a reactor having a circulating coolant system are described (W.D.M.)

2782 (AECL-801(p.206-14)) A SIMPLIFIED INSTRUMENTATION SYSTEM FOR THE 100-kW TRIGA REACTOR. H. A. Thomas. General Atomic Div., General Dynamics Corp., San Diego, Calif.

A simplified instrumentation system for the TRIGA reactor has been developed which greatly reduces the number of components required. It utilizes log and linear recording micromicroammeters obtained from a simple input-impedance conversion of standard recorders, a temperature-compensated solid-state log network covering in excess of seven decades, and a novel period circuit. The count-rate channel is completely transistorized, as are the rod-position indicators which give reproducibility to 0.2%. A servo allows automatic start-up on a preset period and power regulation to better than 1%. The complete system, including the four neutron channels, can be put in a desk-top cabinet. (auth)

2783 (AERE-C/R-2659) A GENERAL PURPOSE INTEGRATING FLAME PHOTOMETER. H. M. Davis, G. P. Fox, R. J. Webb, and P. C. Wildy. United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England. June 1960. 38p. BIS.

A flame photometer with facilities for either direct reading or integration and for automatic background correction is described. A detection limit of 0.0001 ppm lithium can be obtained. (C.J.G.)

2784 (AERE-M-626) ELECTRO-MAGNETIC SPEED SIGNAL AND PULSE GENERATORS FOR NEUTRON CHOPPER SPINNING UNITS. L. V. Lewis. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Aug. 1960. 7p. BIS.

Two simple electromagnetic signal generators are described, and their performance is given. One type generates a continuous sine wave whose amplitude is approximately proportional to rotor speed. The other type generates pulses suitable for triggering a timing unit. (auth)

2785 (AERE-M-720) NANOSECOND 100 OHM DELAY SYSTEM WITH REMOTE CONTROL FACILITIES. A. K. Barlow and J. F. Gibbs. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. July 1960. 13p. BIS.

A system is described which is to be used in conjunction with nuclear counting equipment to provide delays in the

range 2 to 52 nsec. The system employs 100-ohm impedance coaxial cable and incorporates remote-control facilities. (auth)

2786 (AERE-N/M-34) A SAMPLE OSCILLATOR FOR GLEEP. W. G. L. Brownrigg and E. A. Thorne. Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England. Mar. 4, 1949. 4p.

The design of an oscillating apparatus for moving samples from the outside of a reactor shield to the center of the reactor is reported. (C.J.G.)

2787 (AFBMD-TR-60-33) SPACE PHYSICS INSTRUMENTATION. Semiannual Report for July 1–December 31, 1959. Space Technology Labs., Inc., Los Angeles. 97p. Contract AF04(647)-309. (STL/TR-59-0000-09950; AD-235218).

Laboratory prototypes of several new detectors and sensors for use in space experiments were designed and constructed and are being tested. Supporting laboratory equipment was also created. Prototypes of a low-energy β-ray spectrometer and a flux-gate magnetometer were completed. Designs were completed and prototypes nearly finished of a high-energy β-ray spectrometer, a luminescent chamber, a Cherenkov counter detector, a search-coil magnetometer, an open-dynode ultraviolet detector, a nitric oxide chamber for Lyman α detection, and a high-resolution television system. Support work included construction of a pulse-height analyzer, a pulse amplifier, and a Frisch grid counter; design of a "magnetic room" and a capillary ultraviolet source; and circuit reliability studies. (auth)

2788 (AFSWC-TN-60-7) EVALUATION OF THE MINIRAD RADIACMETER. Thomas P. Cain and Florian T. Kokoszka. Air Force Special Weapons Center, Kirtland AFB, N. Mex. Apr. 1960. 35p. Project No. 7805.

A survey of commercially available miniature γ rate meters was undertaken to find a suitable instrument for use in survival kits. As a result of this survey, a decision was reached to purchase 1000 Minirad Radiacmeters for service tests and further evaluation. Field evaluation of the instrument indicated that the Minirad was generally satisfactory for use as a survival-kit instrument. Minor deficiencies were of a nature that could be corrected by design changes and closer inspection in quality control. The Minirad is considered suitable for Air Force use as an interim item of equipment. (auth)

2789 (ARF-3127-15) [AEROSOL GENERATOR DESIGN]. Letter Report. John Rosinski and John Stockham. Illinois Inst. of Tech., Chicago. Armour Research Foundation. Oct. 19, 1960. 3p. Contract AT(11-1)-626. OTS.

An aerosol generator for producing fine particles by a vaporization-condensation technique was built and tested. The aerosols produced by the generator using AgI were about 0.01 to 0.05 μ in diameter. A diagram of the generator is included. (J.R.D.)

2790 (CEA-1400) RÉALISATION D'UN SPECTROMETRE À SCINTILLATIONS ET À PAIRES POUR LA DÉTECTION DES RAYONNEMENTS γ D'ÉNERGIE COMPRISE ENTRE 2 ET 20 Mev. (The Design and Construction of a Scintillation Pair Spectrometer for the Detection of γ Rays in the Energy Range 2-20 Mev. Thesis submitted to Univ. of Grenoble, France.) J. P. Longequeue. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 48p.

The scintillation-pair spectrometer is designed to allow the measurement of the energy of γ rays in the range 2 to 20 Mev. Such an instrument is chosen because of its high energy resolution and ease of working; however, the efficiency is low. It was possible to tolerate this low efficiency because of the facts that the γ rays studied emanated from (p,γ) reactions and that the two electrostatic accelerators available could provide beams of 500 μa having energy maxima at 300 and 600 kev. The γ rays produced by the reactions $Na^{23}(p,\gamma)Mg^{24}$, $F^{19}(p,\alpha\gamma)O^{16}$, and $Li^7(p,\gamma)Be^8$ were used as well as the γ rays emitted by sources of RTh and of Na^{24}. Under these conditions the spectrometer attained a resolving power of 6.5 ± 0.5% at 6.1 Mev, and it was able to separate the 14.8 and 17.6 Mev lines produced by the reaction $Li^7(p,\gamma)Be^8$. As well as this, the efficiency, which varied from 2×10^{-4} to 1.7×10^{-3} between 2 and 20 Mev, was well above the efficiencies already obtained with this type of instrument. (auth)

2791 (CEA-1539) ETUDE DES PERFORMANCES D'UNE CHAMBRE D'IONISATION $4\pi\gamma$. (Study of the Performance of a $4\pi\gamma$ Ionization Chamber). J. J. Engelmann. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 26p.

A description is given of a well type γ chamber for routine measurements of sources between 1 μcurie and 1 curie. Approximate calculation of some geometrical parameters by which the zone of constant sensitivity may be increased is shown. A calculation of the sensitivity of such a chamber is given and compared with the experimental results. (auth)

2792 (CEA-1596) ÉTUDE D'UN PRÉAMPLIFICATEUR POUR LA DÉTECTION D'IMPULSIONS FAIBLES DE NEUTRONS ISSUES D'UN MILIEU CRITIQUE (PROSERPINE). (Study of a Preamplifier for the Detection of Weak Impulses of Neutrons from a Critical Medium (Proserpine)). R. Agaisse. France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay. Jan. 1960. 12p.

In a critical experiment the small detection instruments supply weak impulses which must be brought outside the pile for counting. The important parameter is the ratio of the signal to the background. For the preamplifier studied in this report the background, considered at the input, is 12 microvolts; a factor 2 is thus gained with respect to ordinary preamplifiers. (auth)

2793 (CERN-60-34) LES LIMITES PHYSIQUES DE LA CORRECTION DE TEMPS DE VOL DANS UN PHOTOMULTIPLICATEUR. (Physical Limits of the Time-of-Flight Correction in a Photomultiplier). M. Barbier. European Organization for Nuclear Research, Geneva. Aug. 20, 1960. 78p.

A study of photomultipliers is made to establish their physical limits of performance and to find how they can be improved. The properties of photomultipliers are discussed as preliminary to studies of arrangement of photocathode-first dynode space, passage of electrons through a grid in a photomultiplier, optimum location of a secondary multiplication dynode for low dispersion of time-of-flight, arrangement of the deflection section of the stage, limitations because of space charges in latter stages, practical construction of a fast photomultiplier, and use of photocathodes with a high quantum yield. (T.R.H.)

2794 (CRGP-959) A SLIDE-OPERATED 4π PROPORTIONAL COUNTER. R. L. Brown. Atomic Energy of Canada Ltd., Chalk River, Ont. Sept. 1960. 10p. (AECL-1087). AECL.

The construction, operation, and performance of a slide-operated pillbox 4π flow counter operating in the proportional region are discussed. (C.J.G.)

2795 (ELI-14) THE DESIGN OF A RADIOACTIVITY CONTAMINATION METER. F. S. Goulding. Atomic Energy of Canada Ltd., Chalk River, Ont. Apr. 27, 1954. 47p. (AECL-878). AECL.

A description is given of the design and performance of a portable instrument for measurement of radiation from small quantities of radioactive contamination. The device weighs 4 lb 2 oz, operates on a single flashlight battery for 200 hr, and operates at low temperatures with the proper battery. The most novel feature is a clockwork-driven chopper for a-c. The circuit includes cold cathode tubes and a halogen-quenched G-M tube. Reliability was emphasized in the design. (T.R.H.)

2796 (HW-60404(Rev.)) PORTABLE RADIATION INSTRUMENTATION STANDARDIZATION. W. G. Spear. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. July 1, 1960. 35p. OTS.

Presented at the American Institute of Electrical Engineers, Pacific General Meeting, August 8-12, 1960, San Diego, California.

Radiation instruments of the count-rate-meter type which employ completely transistorized-printed-modular circuits are described. All the detectors except the loudspeaker G-M tube instrument and the alternate BF_3 tube for neutron work are scintillation types employing specific scintillating material as required by the detection problem. Interchangeable transistorized circuitry for the standard detectors is featured. (J.R.D.)

2797 (KAPL-2000-11(p.III.2-III.9)) THERMOCOUPLES AS IN-PILE MONITORS OF FAST AND THERMAL NEUTRON FLUXES. D. Dutina. Knolls Atomic Power Lab., Schenectady, N. Y.

A method is presented for the determination of thermal and fast fluxes inside the pressure vessel of an in-pile loop. The method involves analysis of thermocouple wires for induced Cr^{51} and Co^{58} activity. This method is suggested to loop experimenters as an additional technique available to solve the difficult problem of in-pressure-vessel flux monitoring. A flux profile along 15 in. of the L-42 pressure vessel at MTR has been obtained by the use of this technique. This is the longest such profile to date. Work which is in progress will compare directly the results obtained by this method with those obtained by standard nickel and cobalt wire activations. This work should resolve differences which may exist in results obtained by the use of Cr^{51} as a monitor instead of the standard Co^{60}. (auth)

2798 (LA-2458) A GAMMA RAY SENSITIVE FUEL LEVEL DETECTOR FOR A HOMOGENEOUS REACTOR. Dale M. Holm. Los Alamos Scientific Lab., N. Mex. July 1960. 22p. Contract W-7405-eng-36. OTS.

A γ-sensitive level detector was developed to determine the fuel level in the LAPRE II reactor vessel during the approach to a critical configuration. It was used to compare the calculated and experimentally determined critical fuel volume. Although neutron activation of the detector's NaI crystal prevented level determination while the reactor was at power, the detector provided an accurate means of calibrating an indirect method used for determining fuel level in the reactor. (auth)

2799 (SCR-208) AN IMPROVED FM DISCRIMINATOR-DETECTOR FOR AIRBORNE TELEMETRY RECEIVERS. George E. Reis and Cecil E. Land. Sandia Corp., Albuquerque, N. Mex. Sept. 1960. 26p. OTS.

Presented at the Wescon Convention, Los Angeles, California, August 26, 1960.

Recently the problem of designing an FM receiver for airborne telemetering applications led to a critical evaluation of existing discriminator-detector circuits. Existing circuits were compared on the basis of efficiency, complexity in both design and construction, ease of adjustment, and adaptability to subminiature packaging techniques. This study led to the development of a new discriminator-detector circuit which has been incorporated in various package configurations and has given excellent performance under adverse environmental conditions. When evaluated, stressing the points enumerated above, the circuit has proved to be superior to other circuits similarly evaluated. A qualitative description of the Snyder discriminator-detector circuit is presented. The essential differences between the Snyder circuit and the Weiss discriminator are explained. The validity of the analysis is confirmed by comparison of theoretical predictions and experimental results for a typical circuit. (auth)

2800 (SCTM-176-60(14)) THE USE OF TRANSIENT ANALYSIS IN THE EVALUATION OF ELECTROMAGNETIC RELAYS. R. C. A. Sadler. Sandia Corp., Albuquerque, N. Mex. July 26, 1960. 28p. OTS.

A method of evaluating test effects upon electromagnetic relays through the analysis of their transient response by means of generalized operate and release curves is presented. The curves are developed and units of measure discussed. Effects of circuit parameters, manufacturing tolerances, and stability of adjustment are examined in terms of the generalized curves. Measurement of the significant relay variables is discussed and suggestions offered for the computation of data. (auth)

2801 (SCTM-282-60(14)) A PLUG-IN MAGNETRON RADIO FREQUENCY POWER SOURCE FOR THE ANTENNA PATTERN RANGE FACILITY. J. F. Dankworth. Sandia Corp., Albuquerque, N. Mex. Sept. 6, 1960. 33p. OTS.

The design and operation of a plug-in magnetron r-f power source for the model antenna pattern range facility are described. (auth)

2802 (SCTM-303-60(14)) A DIGITAL COMPARATOR. N. A. Bourgeois, Jr. Sandia Corp., Albuquerque, N. Mex. Sept. 21, 1960. 8p. OTS.

A digital comparator was designed to flag data which goes above a maximum limit or below a minimum limit. (auth)

2803 (TID-6709(Sect.III)) A LOW-LEVEL, LINEAR MICROSECOND GATE. P. R. Chagnon. Sect. III of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts. 8p.

A linear-transmission gate for use in scintillation-counter coincidence experiments is described. The gate is suitable for negative pulses of microsecond duration and is linear over a range of 0.01 to 5 volts. The circuit is relatively simple, uses no vacuum tubes, and is reliable over long periods of use. The use of low-level gates can increase the usable counting rate of a multichannel coincidence system by an order of magnitude. (auth)

2804 (TID-6709(Sect.XII)) AN AUTOMATIC CONTROL SYSTEM FOR THE BETA SPECTROMETER. R. M. Woods, Jr., and M. L. Wiedenbeck. Sect. XII of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Harrison M. Randall Lab. of Physics. 9p.

A completely automatic β spectrometer is described. This includes a transistorized current regulator, photographic data recording, and automatic control. (auth)

2805 (UCRL-5698) A BEAM INFLECTOR. Francis C. Gilbert. California. Univ., Livermore. Lawrence Radiation Lab. Nov. 1959. 7p. Contract W-7405-eng-48. OTS.

An inflector that can transport a beam of charged particles transversely across an intense magnetic field without seriously perturbing that field is described. The inflector consists of a hollow pipe of magnetically permeable material, covered by a current distribution, which is designed in a fashion to offset the perturbation upon the external field. (auth)

2806 (UCRL-6089) MEASURING REACTOR NEUTRON SPECTRA WITH THRESHOLD DETECTORS. Roderick J. Grader. California. Univ., Livermore. Lawrence Radiation Lab. Sept. 23, 1960. 17p. Contract W-7405-eng-48. OTS.

The use of threshold detector foils to measure the external neutron spectrum of the Livermore Pool Type Reactor and the KEWB Reactor is described. The foils employed are Pu^{239} to measure the total fast flux, U^{238} for the region above 1.5 Mev, S^{32} above 2.5 Mev, and Au^{197} for thermal neutrons. Scintillation counters are used to determine the activity induced in the detectors. The foil-counting system is calibrated by using a Cockcroft-Walton accelerator as a fast neutron source. The results indicate a fission type spectrum at each reactor. (auth)

2807 (USNRDL-TR-445) OPTICAL TRANSMISSION MEASUREMENTS OF AN ANTI-FLASH SYSTEM. Robert J. Jenkins and Eugene R. Schleiger. Naval Radiological Defense Lab., San Francisco. July 13, 1960. 39p.

Evaluation tests were performed on an M-65 telescope as modified by the addition of a Kerr cell shutter system to provide observer protection from the intense flash of nuclear weapons. The evaluation tests consisted of the measurement of the transmission through the telescope of the radiant energy from a carbon-arc source and determination of the spectral transmission in the range 0.3 to 3.0μ. A group of filters (polarizing, reflecting, and absorption types) were tested for transmission characteristics and ability to resist intense thermal radiation from a carbon-arc source. (auth)

2808 (USNRDL-TR-447) A TECHNIQUE FOR UNFOLDING GAMMA-RAY SCINTILLATION SPECTROMETER PULSE-HEIGHT DISTRIBUTIONS. N. E. Scofield. Naval Radiological Defense Lab., San Francisco. June 24, 1960. 48p.

An iteration method for unfolding scintillation spectrometer pulse-height distributions was programmed for the digital computer. The method utilizes an experimentally determined scintillation-detector response matrix, the formation of which is described. The method of correction at each iteration is designed to prevent the appearance of negative values for the photon number flux in source-energy bins of the unfolded spectrum. A simple graduating formula is used to smooth oscillations which appear after many iterations. (auth)

2809 (WADD-TN-60-48) DESIGN OF A DUAL SENSOR GAMMA RAY CALORIMETER. Period Covered September 1958–January 1960. James R. Coss and Philip B. Hemmig. Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio. Jan. 27, 1960. 16p. Project No. 7360. OTS.

The theoretical and design considerations for the construction of a dual-sensor γ-ray calorimeter are presented. The advantages of this type of dosimetry over commonly used present day types are pointed out and justified. The small size, high reproducibility, and small expense of this instrument make it a potentially very useful tool for use in radiation-effects programs. The differences in equilibrium temperature attained by two slugs, via γ heating, are measured as a voltage by thermocouples, and this thermocouple voltage is correlated to the dose rate. (auth)

2810 (WAPD-BT-20(p.125-8)) THE THIN COPPER FILM GAGE. R. A. Betz. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

One of the methods investigated for the fabrication of fuel elements for PWR Core 2 was a eutectic diffusion bonding process which required a thin copper film on one of the two surfaces to be bonded. A gage, employing the x-ray fluorescence technique, was developed to measure the critical thickness of this film. A statistically established accuracy of ±0.000004 in. is possible with this gage, which is more than adequate in the range of interest. (auth)

2811 (WT-1452) INSTRUMENTATION OF STRUCTURES FOR AIR-BLAST AND GROUND-SHOCK EFFECTS. J. J. Meszaros, E. G. Schwartz, H. S. Burden, J. D. Day, and C. H. Hoover. Ballistic Research Labs., Aberdeen Proving Ground, Md. Jan. 1960. 75p. Project 30.5 [of] OPERATION PLUMBBOB. OTS.

The objective of Project 30.5 was to provide instrumentation, electronic and self-recording, for obtaining air-blast and ground-shock loading and response of the structures employed by the various structure projects. Included was installation of transducers, recording of transducer signals, and presentation of the recordings as linearized time-dependent plots of the measured variable in the specified appropriate units. A total of 127 recording channels was utilized; of these channels, 75 were used for electronic recording on magnetic tape, 37 were used for self-recording time-dependent gages, and 15 were peak-indicating gages. A basic description of the instrumentation employed in taking the structural measurements for Projects 30.1, 30.2, 30.3, 31.4, and 31.5 is given. Self-recording gages for measuring peak pressures, pressures vs. time, dynamic pressures vs. time, and displacement vs. time are described; electronic gages for obtaining time-dependent records of pressure, dynamic pressure, acceleration, displacement, and earth pressure are described. For each type gage, details are given on the recording mechanism, transducer element, gage mount, calibration, and data presentation. A plot of the field layout is also shown. A tabulation indicating the general success of the instrumentation recording operations and a discussion of anomalies is presented. Recommendations for more effective instrumentation practices are included. (auth)

2812 (AEC-tr-4137) HIGH VACUUM MANOMETERS. [PART] II. A. M. Grigor'ev (Grigoriev). Translated from Pribory i Tekh. Eksp. No. 6, 10-13(1959). 9p. JCL or LC.

Designs of manometers for high-vacuum applications are described. Included are discussions of ionization manometers and magnetic electrodischarge manometers. (J.R.D.)

2813 (AERE-Trans-855) A TRANSISTOR PULSE-HEIGHT DISCRIMINATOR. L. Stanchi. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment) from Strumentazione e Automazione No. 6, 273-8(1959). 14p.

Also issued in Italian as report CNI-21.

A transistor discriminator based on the classical Schmitt circuit is described. The factors which affect

the pulse rise time and the threshold stability are examined, with particular reference to the temperature variation of the threshold. (J.R.D.)

2814 (CEA-tr-A-719) SUR L'EMPLOI DUE COMPTEUR GEIGER POUR LA DÉTERMINATION DES TEXTURES DANS LES MATÉRIAUX MÉTALLIQUES. (Use of a Geiger Counter to Determine Textures in Metallic Materials). F. Haeszner. Translated into French from Metall 12, 89-95(1958). 41p.

Geiger counters have come into wide use in radiography because of two advantages over photographic methods: precise quantitative texture representations are obtained, and the time or duration of exposure is shorter. A review and discussion are presented of some of the problems frequently arising in texture research and how the Geiger counter helps resolve them. The principle of texture determination and representation on a reference sphere is described, and the statistical considerations are treated. Three other possibilities of texture representation are considered: curves of intensity, polar figures, and inverse polar figures. The usefulness of an analysis of numerical values for the texture is also discussed. (T.R.H.)

2815 (CEA-tr-R-854) INDICATEUR AVEC CATHODE MOBILE À PETIT DÉPLACEMENT DES DÉCHARGES DANS UN GAZ. (Movable-Cathode Indicator with Small Displacement for Gas Discharges). L. A. Goncharskiĭ (Goncharski) and M. Ya. (Ia.) Muliarov. Translated into French from Zavodskaya Lab. 22, 496-8 (1956). 8p.

A gas-discharge pulse indicator with a movable cathode is described; it operates on the relation between the priming potential of the discharge and the separating distance. The indicator has a high useful potential and a small displacement. This makes it more sensitive to current variations and its performance is independent of the sensitivity potential ratio. (T.R.H.)

2816 (CEA-tr-R-862) ETUDE DES COMPTEURS À NEUTRONS LENTS. (Study of Slow Neutron Counters). V. Ya. Savel'ev (V. Y. Savelievy) and V. (U.) A. Kononenko. Translated into French from Pribory i Tekh. Ekspt. No. 1, 61-4(1959). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 11132.

2817 (CEA-tr-R-891) STABILISATION DU COURANT D'UN ÉLECTRO-AIMANT. (Stabilization of the Current of an Electromagnet). Z. Sh. Mandzhavidze (Z. Ch. Mandjavidze) and G. E. Chikovani. Translated into French from Pribory i Tekh. Ekspt. No. 3, 69-71 (1957). 9p.

A simple electronic circuit is offered for stabilizing currents up to 300 amps with a precision of ±0.2% and with an input potential variation of ±20% and a charge variation of +50%. A brief analysis is given of the stability of the regulator. (T.R.H.)

2818 (SCL-T-339) HEAVY PARTICLE DETECTOR WITH n-p SILICON JUNCTION. (Detecteur de Particules Lourdes a Jonction n-p au Silicium). Georges Amsel, Pierre Baruch, and Olgierd Smulkowski. Translated by Marcel I. Weinreich (Sandia Corp.) from Compt. rend 250, 1468-70(1960). 4p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 12717.

2819 CORRECTIONS FOR THE ABSORPTION IN THE BACKING FOR A 4π-COUNTER. R. M. Polevoĭ. Atomnaya Energ. 9, 140-2(1960) Aug. (In Russian)

Formulas are developed which are suitable for the correction of simple and complex β spectra for absorption in the backing of a 4-π counter, considering conversion electrons and Auger electrons. (R.V.J.)

2820 SPECTROSCOPY WITH PULSE ANALYZERS. K. Fränz (Telefunken G.m.b.H., Ulm, Ger.). Atomwirtschaft 5, 458-60(1960) Oct. (In German)

Scintillation probes have largely replaced proportional counters in the spectroscopy of high-energy radiation with pulse analyzers. NaI(Tl), CsI(Tl), or organic crystals and plastic scintillators are generally used in γ spectroscopy, anthracene crystals for β spectroscopy, and CsI(Tl) crystals, Frisch gridded chambers, and semiconductor chambers for α particles. These radiation detection instruments are briefly considered. (auth)

2821 COUNTERS IN RADIATION MEASUREMENT TECHNIQUES. G. Boucke (Telefunken G.m.b.H., Ulm, Ger.). Atomwirtschaft 5, 463-5(1960) Oct. (In German)

In addition to the binary scalers largely employed at present, counter tubes are used in radiation measurement as cheaper and simpler electronic counters. Future development tends toward the transistorization of counters and the production of multilayer semiconductor components and micromodule techniques. (auth)

2822 DEVELOPMENT TENDENCIES IN SCINTILLATION COUNTERS. F. H. Rinn (Siemens & Halske A. G., Karlsruhe, Ger.). Atomwirtschaft 5, 465-8(1960) Oct. (In German)

The development of scintillation counters is making possible their utilization in areas where heretofore they could not be used. These developments are reviewed. The development of cesium iodide, glass, and gaseous scintillators is first described. Then multiplier tubes are discussed with a consideration of the improvements of the present types, the high-current multiplier, and multipliers with a large photocathode. (J.S.R.)

2823 TRANSISTORS IN RADIATION MEASUREMENT INSTRUMENTS. J. Schulz (Telefunken G.m.b.H., Ulm, Ger.). Atomwirtschaft 5, 473-4(1960) Oct. (In German)

The transistor, in spite of its technical deficiencies and the difficult development work necessitated by these deficiencies, has brought important advances in the technology of radiation detection instruments because of its small size, its low power needs, and its long life expectancy. The utilization of transistors in this area is briefly reviewed. (J.S.R.)

2824 UNIT CONSTRUCTION METHODS IN RADIATION MEASURING EQUIPMENT. S. Müller (Frieseke & Hoepfner G.m.b.H., Erlangen, Ger.). Atomwirtschaft 5, 475-8(1960) Oct. (In German)

The growing and often contradictory requirements of radiation-detection instruments cannot be met either by a limited number of standard instruments or by an overlarge differentiation of apparatus. One solution lies in a compact scheme of individual function units which are developed as standardized component blocks. They can be combined as desired to meet individual measurement problems or even for automatic measurement. (auth)

2825 MEASUREMENT PROBLEMS IN HIGH ENERGY PHYSICS. Gerhard Horlitz (Deutsche Elektronen-Synchrotron, Hamburg). Atomwirtschaft 5, 479-81(1960) Oct. (In German)

In high-energy physics the processing of data in a rational manner is a problem that follows the measurement itself. The manipulation and storage of data therefore

merit special interest. Because of the high operating costs of large accelerators, measuring arrangements which hold to a minimum the time required for individual experiments must be created. (auth)

2826 A PLATINUM-WIRE RECORDING MANOMETER. Jacques Lacour and Claude Moreau (Centre d'Études Nucléaires, Grenoble, France). Bull. soc. chim. France, 917-22(1959). (In French) (CEA-1353)

This instrument, designed to measure pressures of from 10^{-1} to 760 mm of mercury, is intended to replace the usual devices based on reading levels in a manometer. It also records the measurements with good precision. (auth)

2827 THE USE OF A MIXTURE OF ARGON AND ETHYLENE IN FLOW COUNTERS IN THE GEIGER REGION. R. Tykva and D. Grünberger (Czechoslovak Academy of Science, Prague). Collection Czechoslov. Chem. Communs. 25, 2464-5(1960) Sept. (In English)

The performance of Geiger counters filled with a mixture of argon and ethylene prepared in two different ways was examined. In one case the ethylene was prepared by dehydration of ethyl alcohol on alumina and the gas formed was purified. The argon was passed through two traps before being passed into the ethylene. In the second case commercial ethylene was used and the argon was directly passed into the ethylene. The results obtained in the measurement of the activity of one sample are reproducible and equal within the range of statistical deviations for both mixtures used at the same time. The characteristics of the counter did not display any essential difference. (J.S.R.)

2828 TELEMETERING RADIATION DATA BY FREQUENCY VARIATION. Hans Kohn Richards (Argonne National Lab., Ill.). Electronics 33, No. 46, 84-7(1960) Nov. 11.

Several methods are given for detecting ionizing radiation and transmitting the information by radiofrequency to the monitoring station; the ionization current of ion chambers or pulses from Geiger counters is used to vary the reactance of a frequency-determining network of a high-frequency oscillator connected to an antenna which then transmits the information; the signal is displayed on an oscilloscope. One method employs an ion chamber with a moveable-vane electrometer, while another has an ion chamber with a nonlinear capacitance. Complete circuit diagrams for each of these methods are given. (D.L.C.)

2829 A TRANSDUCER FOR THE MEASUREMENT OF HEAT-FLOW RATE. Robert Gardon (Pittsburgh Plate Glass Co., Pittsburgh). J. Heat Transfer 82, 396-8(1960) Nov.

A transducer originally devised for rapidly measuring high-intensity thermal radiation was adapted to measure the rate of heat transfer across the surface of a solid. This circular-foil heat-flow meter is designed so that a thermocouple is obtained which measures directly the temperature difference of interest. It differs from other transducers in that it is mounted in the body under study, not between the two media exchanging heat. Its small size permits the measured heat-flow rate to be associated with definite locations on the heat-transfer surface. (M.C.G.)

2830 SCINTILLATION PAIR SPECTROMETER FOR γ RADIATION OF ENERGIES UP TO 20 Mev. J. P. Longequeue (Centre d'Études Nucléaires, Grenoble, France and Université, Grenoble, France). J. phys. radium 20, Suppl. to No. 4, 37A-40A(1959) Apr. (In French) (CEA-1352)

A scintillation pair spectrometer was built to measure the energy of γ rays given by (p,γ) reactions. This spectrometer proved capable of measuring energies in the range from 2 to 20 Mev. Its resolution is $(6.5 \pm 0.5)\%$ at 6.1 Mev. Its efficiency varies from 2×10^{-4} to 1.7×10^{-3} between 2 and 20 Mev. (auth)

2831 EVIDENCE OF PULSE PRODUCED BY ALPHA PARTICLES IN IONIZATION CHAMBERS FILLED WITH LIQUID HEXANE AT LABORATORY TEMPERATURES. Daniel Blanc and Jacques Mathieu (Faculté des Sciences, Toulouse). J. phys. radium 21, 675-6(1960) Aug.-Sept. (In French)

A study was made to confirm the existence of and define the mechanism of ionic multiplication processes in ionization chambers filled with liquid hexane, when the applied electric field is very intense. The variation, as a function of the intensity of the electric field, of the ionization current, and of the maximum pulse height, confirms the existence of ionic multiplication processes in liquid hexane. (J.S.R.)

2832 RECENTLY DEVELOPED TYPES OF G-M COUNTERS IN CZECHOSLOVAKIA. Josef Šilar and Zdeněk Pavlíček (Tesla-Liberec Research Inst., Prague). Jaderná energie 6, 240-3(1960) July. (In Czech.)

The operating characteristics and the basic parameters of a series of improved G-M counters currently in use in Czechoslovakia are described. The counters are divided in the following categories: high-voltage counters with a mica window; proportional counters; all-glass high-voltage counters; halogen type low-voltage β and γ counters; and halogen type counters with a mica window. The halogen-quenched detectors were only recently introduced into Czechoslovakia and their operating characteristics, as well as the characteristics of the polyatomic–organic-quenched high-voltage detectors, are given. These instruments present the advantage of being insensitive to light and to temperature changes and having a high gas efficiency, a long life, and a long plateau. (TTT)

2833 PRESENT STATUS OF SCINTILLATION SPECTROMETRY OF GAMMA RADIATION. Josef Kajfosz and Jiří Kopecký (Československá Akademie Věd, Prague). Jaderna energie 6, 272-8(1960). (In Czech.)

A survey is presented that describes the principal typical methods of spectrometry and analyzes their effectiveness in the measurement of the energy and intensity of γ radiation. In addition to the general description of spectrometry (diffraction, scintillation, and spectrometry with a magnetic field), a survey of recent literature is presented based on the following objectives: new procedures in scintillation spectrometry, new designs and aims of new general instrumentation in the field of spectrometry, improvements in discrimination, and a trend toward multiple-crystal spectrometry. (TTT)

2834 STANDARDIZATION AND CALIBRATION OF RADIATION PROTECTION INSTRUMENTS. RADIATION PROTECTION IN REACTORS AND IN NUCLEAR SCIENCE PLANTS, RADIATION PROTECTION COURSE. M. Oberhofer (Technische Hochschule, Munich). Kerntechnik 2, 276-81(1960) Sept. (In German)

Distinctions between the standardization and calibration of radiation detection instruments are first discussed. A survey is then made on standardization and calibration methods for dose and dose power measurements. Calibrations of x-ray dosimeters or of x-ray dose power measurement instruments are made either with secondary standard ionization chambers or radioactive standard preparations. The knowledge of the relationship between the activity of the standard preparation and the dose power at a given dis-

tance is necessary in the calibration by the second method. Some remarks are made on the calibration of β dosimeters, and β dose power measurement instruments are given. (tr-auth)

2835 ADAPTING LEAD-HOUSING FOR THE OPERATION WITH END WINDOW COUNTERS. V. A. Khitun. Med. Radiol. 5, No. 9, 91-2(1960) Sept. (In Russian)

The design and specifications are given of a lead container for end-window counters. (R.V.J.)

2836 RADIATION SAFETY AND CONTROL. II. THE FILM BADGE AND ELECTROSCOPE. A. R. Gould (Royal Military Coll. of Science, [Swindon, Eng.]). Nuclear Energy, 421-4(1960) Sept.

The exposure of an individual to external radiation may be monitored by simple dosage recorders such as the film badge. The condenser chamber or electroscope dosimeter is used to record the integrated dose at various positions in the environment. A small metal disk of natural isotopic uranium was found to be a convenient source for a calibration standard for personnel monitoring films. The quartz fiber pocket electroscopes were found to be of similar sensitivity to the photographic films when exposed under similar conditions. Dosimeters may be checked as frequently as required without the need for processing or maintenance. If the source of radiation is known, then pulse counting devices may be calibrated for assessment of dose rates from the natural background level upward. (M.C.G.)

2837 LINEAR PULSE AMPLIFIER. Zdzisław Kachlicki, Witold Suwalski, and Zygmunt Szwaja (Poznań Tech. High School, Poland). Nukleonika 5, 569-73(1960). (In Polish)

A linear pulse amplifier with an amplitude discriminator is described. The set consists of a preamplifier, a main amplifier, and a stabilized power supply. The over-all amplification is 120 dB in the frequency range from 10 kc/sec to 3 Mc/sec. The differentiating and integrating circuits form a facility for narrowing the bandwidth. It is possible to select pulse amplitudes exceeding a preset value utilizing the discriminator output provided. (auth)

2838 PRECISE DEPTH MEASUREMENT IN NUCLEAR EMULSIONS. D. Heughebaert and J. Heughebaert (Instituto Nazionale di Fisica Nucleare, Milan). Nuovo cimento (10) 16, Suppl. No. 2, 147-52(1960). (In French)

Depth measurements in nuclear emulsions are generally made with a micrometric screw the precision of which is not sufficient. A simple device is described which allows successive focusing on grains at different levels in the plate without moving the objective. The principle of the device consists in changing the optical path by moving the ocular along the optical axis. The device can be used routinely on all microscopes. Measurements of depth within an emulsion are possible to a precision of 0.1 μm over a path of 20 μ. The gain in precision with the device was evaluated on measurements of the inclination of tracks in Ilford G-5, K-5, and L-4 emulsions. The device is particularly useful with fine-grain emulsions. It is shown to be especially useful in cases where measurements are to be made on a short portion of a track or where the inclination is slight. A simple mechanism for transferring the readings is used. (T.R.H.)

2839 COUNTING RATES OF WIDE APERTURE COSMIC RAY COUNTER TELESCOPES. D. Stern (Israel Inst. of Tech., Haifa). Nuovo cimento (10) 16, Suppl. No. 2, 153-8(1960). (In English)

The wide-aperture cosmic-ray telescope combines a high counting rate with sensitivity to the angular distribution of the particles passing it. Therefore, a wide-aperture counter setup may be used to determine angular distributions where total rates are low (i.e. underground) or to monitor fluctuations affecting angular distributions, where statistical accuracy demands high counting rates. A general method for computing the counting rate of rectangular telescopes for $\cos^{\rho}\theta$ angular distributions was developed, and actual computation carried out for some cases. An experiment embodying the above principles, in which the angular distribution of muons underground was investigated, is described. (auth)

2840 A GAS CHERENKOV COUNTER WITH YIELD APPROACHING UNITY. M. Beneventano (Istituto Nazionale di Fisica Nucleare, Rome and Università, Rome). E. De Agostino, B. Rispoli, and A. Serra. Nuovo cimento (10) 16, Suppl. No. 2, 159-67(1960). (In Italian)

Measurements of the efficiency of a gas-filled Cherenkov counter are given. The efficiency, taking into account the spectrum of cosmic muons of momentum greater than 1.75 Bev/c, as a function of the gas pressure, was found to be $(97.10 \pm 0.50)\%$ at 8.1 atm. The efficiency for particles having $\beta = 1$ should be at 10 atm $F(c) = (99.45 \pm 0.06)\%$. (auth)

2841 THREE LITERS LIQUID HYDROGEN BUBBLE CHAMBER. P. Bassi, R. Cano, S. Focardi, G. Gialanella, A. Michelini, and F. Saporetti (Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10) 16, Suppl. No. 2, 184-91(1960). (In English)

A 3-liter liquid-hydrogen bubble chamber is described. The total consumption of liquid hydrogen was 1.1 liters/hr. The distortions were negligible. (auth)

2842 SEMI-CUBICAL G.M. COUNTER TELESCOPE SYSTEM FOR UNDERGROUND REGISTRATION OF THE MESON INTENSITY OF THE COSMIC RADIATION. T. Sándor, A. Somogyi, and F. Telbisz (Central Research Inst. of Physics, Budapest). Nuovo cimento (10) 16, Suppl. No. 2, 209-14(1960). (In English)

A semicubical telescope system is described which was built for the registration of the high-energy-meson component of the cosmic radiation. A method elaborated to check the stability was applied to the data obtained during the period Mar. 1958 to Feb. 1959. (auth)

2843 A HIGH-SENSITIVITY MASS SPECTROMETER. G. Boato, R. Sanna, and M. E. Vallauri (Università, Geneva and Istituto Nazionale di Fisica Nucleare, Geneva) and M. Reinharz. Nuovo cimento (10) 16, Suppl. No. 2, 215-31 (1960). (In Italian)

A mass spectrometer particularly suitable for measuring small variations of the isotopic-abundance ratio in light gaseous elements was entirely designed and put into operation at the Physics Department of the University of Genoa. Three instruments, differing from each other in minor details, were built, two of which are in use at the Physics Department in Genoa. The third instrument was handed over to the Laboratory of Nuclear Geology at University of Pisa, where it is routinely measuring natural isotopic abundances, including paleotemperatures. Details are given of special features of the mass spectrometer which make it different from similar models constructed abroad. The operating conditions of the instrument are given. The over-all sensitivity of the mass spectrometer is about one part over two million. A precision of one per mil in the measurement of isotopic abundance variations can be easily reached in the case of favorable isotopic ratios. (auth)

2844 CONTRIBUTION TO DEVELOPMENT OF STACKS OF NUCLEAR EMULSIONS. A. Garin, M. Lévi,

and H. Faraggi (Centre d'Etudes Nucleaires, Saclay, France). Nuovo cimento (10) 16, 240-4(1960). (In Italian)

It is possible to obtain satisfactory development of K-5 emulsions using only four constituents: amidol, sodium sulfite, citric acid, and hyposulfite. In the processing the pH of the different baths should remain between 6 and 6.8. (tr-auth)

2845 INVESTIGATIONS ON A HYPERSENSITIZED ILFORD EMULSION. E. Dahl-Jensen (Univ. of Copenhagen). Nuovo cimento (10) 16, Suppl. No. 2, 245-50(1960). (In English)

A new experimental nuclear emulsion of very high sensitivity was produced. It is of the K-5 type but, having been hypersensitized, has a sensitivity which is nearly doubled with respect to the ordinary K-5 emulsion. The keeping qualities of the exposed plates are described, together with some discussion of the variation of the sensitivity from surface to glass. The relationship between the development time in an Amidol developer and the corresponding sensitivity are described. (auth)

2846 MULTICHANNEL TRANSISTORIZED APPARATUS FOR DATA RECORDING. D. Brini, A. Gandolfi, and G. L. Tabellini (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10) 16, Suppl. No. 2, 259-67(1960). (In English)

An apparatus planned to continuously record data, relative to fixed measurement periods, from various counting channels is described. In particular, this device will be used in conjunction with a cosmic ray station to detect short-period intensity variations. There are 24 counting channels and 2880 data readings are recorded for each channel per day. The measurement period is 30 sec. The maximum capacity for each datum is about 100,000 counts. The memorization is made on photographic film. This method is economical, allows a considerable volume, and offers the possibility of visual and automatical reading and elaboration of data. The apparatus has an independent power supply. (auth)

2847 UNIVERSAL HIGH-RESOLVING POWER ELECTROSTATIC ELECTRON SPECTROGRAPH WITH THE ENERGY OF 75 kev. A. N. Kabanov. Pribory i Tekh. Ekspt. No. 4, 23-8(1960) July-Aug. (In Russian)

The design and construction of an electron energy analyzer with a single electrostatic lens with plane symmetry are given. The resolving power of the analyzer is 150,000 : 1 for 75-kev electrons. The apparatus can be used as an electron microscope, electronograph, or ion energy analyzer. (tr-auth)

2848 TRANSPORTABLE AUTOMATIC SINGLE-CHANNEL SCINTILLATION GAMMA-SPECTROMETER WITH TRANSISTORS. A. N. Pisarevskiĭ, L. D. Soshin, and Yu. E. Selyaninov (Radium Inst., Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 4, 29-35(1960) July-Aug. (In Russian)

A field-type, automatic, transistorized scintillation spectrometer is described. The apparatus weighs 20 kg. (tr-auth)

2849 ANALYSIS OF DOUBLE-CRYSTAL SPECTROMETER PERFORMANCE AND PRECISION. V. V. Shmidt (Inst. of Metallurgy, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 4, 36-9(1960) July-Aug. (In Russian)

The influence of bending in the (1, −1) and (1, +1) positions is analyzed. Two cases of crystal bending are examined: the case in which the rotation axis of the second crystal forms an angle with the reflecting plane of the first crystal and the case where the rotation axis of the second crystal is parallel to the reflecting plane of the first crystal. It is shown that when the bend angle does not exceed 1′, the expansion of the reflecting curve in (1, −1) does not exceed 1″ and the spectral line in (1, +1) expands about 10%. (tr-auth)

2850 SPECTROMETER FOR MEASURING FAST NEUTRONS BY TIME OF FLIGHT. E. A. Zherebin and E. A. Tamanov. Pribory i Tekh. Ekspt. No. 4, 40-5(1960) July-Aug. (In Russian)

Descriptions are given of a simple device for measuring time intervals in the nanosecond range. The device is based on a proportion between pulse amplitudes obtained with an ordinary multichannel analyzer and measured time intervals. The apparatus is applied in neutron time-of-flight studies. Neutron spectra from (D,D) and (D,T) reactions are included. (tr-auth)

2851 PULSED NEUTRON SOURCE. G. S. Malkiel and B. I. Sukhanov. Pribory i Tekh. Ekspt. No. 4, 46-50(1960) July-Aug. (In Russian)

A neutron source is described which produces 14-Mev neutron pulses of 10^{-6} to 10^{-3} sec at a frequency of 500 Hz. The neutron flux of the pulse is 10^{12} n/sec. A short description of an electronic device for measuring neutron energies by the time-of-flight method is included. (R.V.J.)

2852 SEMI-AUTOMATIC COLORIMETER FOR SCANNING STEREOPHOTOGRAPHS. A. T. Vasilenko, M. M. Kulyukin, R. M. Sulyaev, A. I. Filippov, and Yu. A. Shcherbakov (Joint Inst. of Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt. No. 4, 56-63(1960) July-Aug. (In Russian)

Descriptions are presented of an instrument for processing stereophotographs. The instrument will scan three tracks simultaneously and record the results on perforated ribbons. (tr-auth)

2853 NOMOGRAMS FOR EVALUATING TRACKS IN EMULSIONS. G. V. Koshelyaev (Moscow State Univ.). Pribory i Tekh. Ekspt. No. 4, 63-6(1960) July-Aug. (In Russian)

A set of nomograms is suggested for evaluating measurements taken on tracks and stars in nuclear emulsions. The method of application is discussed. (R.V.J.)

2854 EVALUATION OF PULSE SPECTRUM SHAPES IN IONIZATION CHAMBERS. A. I. Abramov. Pribory i Tekh. Ekspt. No. 4, 66-71(1960) July-Aug. (In Russian)

Pulse distortions in He^3 ionization chambers as a result of wall induction effects are analyzed. Evaluations are made of the curves indicating the magnitude of the effects as a function of chamber parameters and the filling mixture. (tr-auth)

2855 SEPARATION OF PARTICLES BY MAGNITUDE OF IONIZATION IN VARIOUS SCINTILLATION COUNTERS. Yu. K. Akimov, V. I. Komarov, O. V. Savchenko, and L. M. Soroko (Joint Inst. of Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt. No. 4, 71-7(1960) July-Aug. (In Russian)

Descriptions are given of a telescope, consisting of several scintillation counters, capable of recording rare emissions of highly ionized particles with small trajectories in a background of other emissions of smaller ionization. The counters use ordinary plastic scintillators 6 mm in thickness and 5 mm films of polystyrene with a 1% admixture of tetraphenylbutadiene. The characteristics are given of a telescope for separating deuterons from protons at p = 900 Mev/sec pulses, He^3 from deu-

terons at p = 730 Mev/sec, and α particles of 800 Mev. The described apparatus was used in studies of $p + d \rightarrow He^3 + \pi^+$, $d + d \rightarrow He^3 + n$, and $d + d \rightarrow \pi^0 + He^4$. (R.V.J.)

2856 DOUBLE FOCUSING MASS-SPECTROMETER FOR MEASURING ISOTOPIC MASS. V. Shyutse, R. A. Demirkhanov, T. I. Gutkin, O. A. Samadashvili, and I. K. Karpenko. Pribory i Tekh. Ekspt. No. 4, 92-8(1960) July-Aug. (In Russian)

The design is presented of a mass spectrograph with double-focusing for all masses. The principle ion-optical parameters of the system are as follows: the angle of ion deflection in the electric field is $\Phi_m = 31°50'$, the angle of deflections in the magnetic field is $\Phi_m = 90°$, and the radius of the ion trajectory in the electric field is $r_e = 510$ mm. The line widths of 1.5 to 2μ, corresponding to a resolving capacity of 120,000, were achieved by means of large linear dimensions, high stability of the deflecting field, and precision of the arrangement. The dispersion per % of mass varies from 0.25 to 2.25 mm. Stability along the total mass was achieved with the constant magnet. (tr-auth)

2857 STAGE MASS SPECTROMETER FOR STUDYING LOW-VOLATILITY SUBSTANCES. P. A. Akishin, L. N. Gorokhov, O. T. Nikitin, and Yu. S. Khodeev (Moscow State Univ.). Pribory i Tekh. Ekspt. No. 4, 98-102(1960) July-Aug. (In Russian)

Specifications are given of the MS-3 mass spectrometer for measuring the thermodynamic characteristics of low-volatility evaporation products. The performance and results obtained with the device are described. (tr-auth)

2858 MEASUREMENTS OF THIN COATINGS ON THICK BASES. V. Ya. Dudarev (Moscow State Univ.). Pribory i Tekh. Ekspt. No. 4, 123-6(1960) July-Aug. (In Russian)

Two principles are discussed for measuring thin coatings on thick bases. In the first, measurements are made by γ-ray absorption in the coating following reflection from the base. In the second, comparisons are made of the intensity of x rays reflected from an infinitely thick coating and from each point of a finite thickness, not exceeding a certain maximum. Descriptions are given of a device capable of continuously measuring the thickness of a coating along the length of a specimen. Measurable thicknesses are from tenths of a micron to several hundred microns. The precision is within ±10%. (tr-auth)

2859 AUTOMATIC MEASUREMENTS OF COUNTING CHARACTERISTICS IN GAS DISCHARGE COUNTERS. V. V. Siderenko and G. A. Utkin. Pribory i Tekh. Ekspt. No. 4, 133-4(1960) July-Aug. (In Russian)

The scheme consists of a counting device with an automatic potentiometer with two additionals: a pulse amplifier and a tube voltmeter. A block diagram of the system and its recording characteristics are given. (R.V.J.)

2860 FLUOROPLASTIC INSULATORS FOR IONIZATION CHAMBERS AND COUNTERS. V. N. Dmitriev, L. V. Drapchinskiĭ, and Yu. F. Romanov (Radium Inst., Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 4, 135 (1960) July-Aug. (In Russian)

Fluoroplastic insulators of 40 × 10 mm^2 were used in ionization chambers above 10 kv. The insulators were tested at pressures from several mm of mercury to 4 atm. The insulators proved to have the best electrical, chemical, and mechanical properties. (R.V.J.)

2861 A REMOTELY CONTROLLED NEUTRON DIFFRACTOMETER BASED ON A GUR-3 UNIT. R. P. Ozerov, S. V. Kiselev, I. R. Karpovich, V. I. Goman'kov, and A. A. Loshmanov (Karpov Inst. of Physical Chemistry, [USSR]). Soviet Phys.-Cryst. 5, 294-6(1960) Sept.-Oct.

The modifications needed to convert a GUR-3 universal x-ray goniometer to a neutron diffractometer are described. The angles are read by means of BD-404A selsyns which have errors of ±0.2 to 0.3°. A distributed load of about 5 kg is the maximum permissible for the GUR-3. It can be screened as a whole by means of an independently supported shield which can reduce the neutron background to a few counts a minute even in regions with strong background flux. The diffraction pattern is recorded automatically. (M.C.G.)

2862 A CRYOSTAT FOR USE AT HYDROGEN AND HELIUM TEMPERATURES IN NEUTRON-DIFFRACTION STUDIES. V. S. Kogan, B. G. Lazarev, G. S. Zhadanov, and R. P. Ozerov (Karpov Inst. of Physical Chemistry, [USSR]). Soviet Phys.-Cryst. 5, 297-8(1960) Sept.-Oct.

A cryostat was developed for use in neutron-diffraction studies at liquid hydrogen or helium temperatures. The vessel containing the coolant is enclosed by a vessel containing liquid nitrogen. The vessel is fitted with copper gauze to equalize the temperature. The temperature in the inner vessel is measured in terms of the vapor pressure of the liquid. The cryostat was used in studies of hydrogen isotopes at 10 to 12°K. The results for deuterium agreed with those obtained with x rays, but those for hydrogen did not. (M.C.G.)

2863 ELIMINATION OF THE RADIAL SECOND ORDER ANGULAR ABERRATIONS IN INHOMOGENEOUS FIELD MASS SPECTROMETERS BY INCLINED PLANE BOUNDARIES. H. A. Tasman and A. J. H. Boerboom (Laboratorium voor Massaspectrografie, Amsterdam). Z. Naturforsch. 15a, 736-8(1960) Aug. (In English)

The rather complicated expressions for the ion-optical properties of inhomogeneous magnetic sector fields can be reduced considerably if the discussion is restricted to a symmetric arrangement with plane boundaries where objec and image distances are equal. On the basis of the above simplification, the elimination of α^2 and α_2^2 aberrations is considered. (J.S.R.)

2864 GAMMA MONITORING OF LAND SURFACES. I. L. Ophel and A. R. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.339-43 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Rapid monitoring of land surfaces is useful in delineating the area affected by an accident involving air-borne contamination or detecting long-term contamination of the environment. A rugged monitor capable of making a continuous record when carried on a vehicle was used for carrying out a preoperational survey of the area surrounding the site of the Canadian demonstration power reactor (NPD) near Chalk River. It consists of an anthracene crystal γ-ray detector with a photomultiplier, pulse-amplifier counting-rate circuit, d-c amplifier, and 1-ma recorder train. This equipment weighs 28 kg and is mounted with two bolts on the bumper of a jeep. It can be dismounted and set up on a tripod at the same height above the ground. The mercury batteries are kept inside the vehicle. The circuitry is transistorized. A jig is fitted to carry a standard radium calibration source. The instrument is insensitive to cosmic radiation, and when the vehicle was driven at 16 km/h readings were 80% of those obtained if the counter was stationary. A road survey of the NPD reactor area, with readings taken at fixed check points 100 m from the roadway

and 3.2 km apart, showed that the recorded background radiation on the roads was very uniform, averaging 6 μr/h. Check-point readings varied from 4.5 to 7.0 μr/h. (auth)

2865 APPLICATIONS OF COMMERCIAL OPERATIONAL AMPLIFIERS IN INSTRUMENTATION FOR CHEMICAL ANALYSES. M. T. Kelley, D. J. Fisher, H. C. Jones, W. L. Maddox, and R. W. Stelzner (Oak Ridge National Lab., Tenn.). Preprint No. NY60-52. Presented at Fall Instrument-Automation Conference and Exhibit, New York City, September 25-30, 1960. Pittsburgh, Instrument Society of America, 1960. 17p.

Analog-computer type operational amplifiers that are stable and have high gain and a band width from d-c to several kc are commercially available. The external networks that these amplifiers activate and whose impedance functions are enforced through negative feedback may consist of electrochemical cells or of linear elements. Such systems were profitably utilized in the design of instrumentation for chemical analysis. By placing an electrochemical cell in the feedback loop, electrolysis may be forced to occur at constant current. This has been applied to chronopotentiometry and could be used for coulometric titration. If a third electrode is placed in the cell for voltage reference and connected into the input loop, electrolysis may be performed at controlled or limited potential. This technique was applied in an automatic electronic controlled-potential coulometric titrator, a controlled-potential and derivative polarograph, and an a-c controlled-potential polarograph. Voltage amplification at d-c or at a tuned frequency may accomplish impedance matching in addition to amplification. Very frequency-selective amplifiers with parallel-T, RC feedback networks are used for the measurement of chopped low-level light sources. Operational amplifiers are used for current amplification in the polarographs, in a flame spectrophotometer, and in a spectrographic read-out device. A differential amplifier connected as a voltage-crossing detector may be used for automatic cutoff at a preset endpoint potential. This configuration is being used to obtain the readout of transition time in a chronopotentiometer. A potential-sensing relay circuit is also used for readout of chronopotentiometric transition time. A current integrator with a constant-potential input may be used to generate a linear voltage sweep. This is being used in polarographs and for fast pulse-energy scanning in a gamma spectrometer. The operational amplifier systems are being used for data transformation circuits that are integral parts of analytical instruments: voltage follower, inverter, voltage and current amplifiers, current averager, current peak follower, current integrator, and derivative computer. Practical analytical applications of these systems are described and some results are presented. (auth)

2866 IMPROVEMENTS IN OR RELATING TO MAGNETIC MASS SPECTROMETERS FOR SEPARATING IONIZED PARTICLES. (to Commissariat à l'Énergie Atomique). British Patent 850,627. Oct. 5, 1960.

A mass spectrometer was invented in which the focusing of the beams can be controlled to obtain better separation without displacing the collector or adjusting the spectrometer. Control is accomplished by regulating the current in windings located against the magnet pole pieces. Drawings illustrating the invention are included in which the windings for correcting the focal distance are superimposed on windings for coma correction (see Patent Serial No. 850,628). Complete details of the theory of the windings are given for the calculation of the best winding conditions. (D.L.C.)

2867 IMPROVEMENTS IN OR RELATING TO MAGNETIC MASS SPECTROMETERS FOR SEPARATING IONIZED PARTICLES. (to Commissariat à l'Énergie Atomique). British Patent 850,628. Oct. 5, 1960.

A mass spectrometer was invented in which the excessive curving of beams on either side of the mean orbit (so-called coma defect) is corrected by means of a sheet of windings distributed along the magnet pole pieces. In this way, better beam separation can be obtained. Drawings illustrating the invention are included in which the coma correction windings are superimposed on the focal distance correction windings (see Patent Serial No. 850,627). Equations are given for deriving the best winding conditions. (D.L.C.)

2868 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR MEASURING AND RECORDING THE INTENSITY DISTRIBUTION OF RADIATION EMANATING FROM RADIO-ACTIVE ISOTOPES, BY LINEAR SCANNING. (to Siemens-Reiniger-Werke, A. G.). British Patent 850,678. Oct. 5, 1960.

An apparatus for measuring and recording the intensity distribution of radiation from radioisotopes by linear scanning is designed so that the measuring head can be operated either in the vertical or horizontal plane with the recording surface and the operating knobs remaining in the same plane. This apparatus should be useful in recording the distribution of radioiodine in the thyroid gland. (D.L.C.)

2869 IMPROVEMENTS IN OR RELATING TO ACCELEROMETERS. Kenneth Elvin Pope (to United States Atomic Energy Commission). British Patent 850,945. Oct. 12, 1960.

A simple, compact accelerometer was invented which is of rugged construction, not susceptible to temperature changes, and applicable to a considerable range of accelerations and velocities. It comprises a support, a means for angular displacement in response to acceleration of the support in a given direction, and an electric rotor to oppose the angular displacement. It may also be designed to give a circuit opening or closing signal upon traveling a predetermined distance. (D.L.C.)

Materials Testing

2870 (NP-9053(Pt.III)) SHOCK, VIBRATION AND ASSOCIATED ENVIRONMENTS. PART III. BULLETIN NO. 28. Office of the Assistant Secretary of Defense (Research and Engineering), Washington, D. C. Sept. 1960. 335p.

The 28th Symposium on Shock, Vibration and Associated Environments was held in the Departmental and Commerce Auditoriums, Washington, D. C., February 9-11, 1960.

This volume presents information on hot-war environments, studies of blast effects, measurement and data, simulation, equipment design, and structural design. (W.L.H.)

2871 (NP-9053(Pt.IV)) SHOCK, VIBRATION AND ASSOCIATED ENVIRONMENTS. PART IV. BULLETIN NO. 28. Office of the Assistant Secretary of Defense (Research and Engineering), Washington, D. C. Aug. 1960. 288p.

The 28th Symposium on Shock, Vibration and Associated Environments was held in the Departmental and Commerce Auditoriums, Washington, D. C., February 9-11, 1960.

This volume presents design problems and solutions, test methods and techniques, instrumentation and data analysis, and information exchange relating to shock and vibration. (W.L.H.)

2872 (TID-6641) IMPACT DEFORMATION TEST NO. 1 WITH SIMPLIFIED AIRCRAFT MODEL. W. E. Greenwald and G. P. Kerr. General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. July 31, 1960. 29p. Contracts AF33(600)-38062 and AT(11-1)-171. (XDC-60-8-17). OTS.

To evaluate an analytical approach to the impact deformation of a simplified aircraft structure in which the crew compartment, reactor, and fuselage form a double spring mass system, a high velocity impact test was performed on a physical model. The model, consisting of cylindrical 4- and 6-lb masses separated from each other and from the 50-lb projectile by thin-walled aluminum cylinders, was instrumented with strain gages at various locations, an accelerometer in each of the two masses, and marked with reference lines for photographic measurement of the collapse and motion. The displacement and accelerations measured confirmed theoretical predictions in most cases. A notable exception was the apparent dynamic critical buckling strengths, which were considerably larger than those predicted. (auth)

2873 (WAPD-T-1172) SELECTION, TRAINING, AND QUALIFICATION OF INSPECTION PERSONNEL FOR MAGNETIC PARTICLE AND LIQUID PENETRANT TESTING. D. L. Garland. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh. 1960. 9p. Contract AT-11-1-GEN-14. OTS.

The qualifications that are necessary for the selection of inspection personnel for nondestructive testing are described. The training programs that are used by various companies are listed. Standards for welding of reactor systems and components are given. (W.L.H.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

2874 (AERE-R-3224) AN AERIAL RADIOMETRIC SURVEY OF PARTS OF KENYA AND TANGANYIKA. R. S. Cambray and W. G. Hill. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Sept. 1960. 22p. BIS.

An aerial radiometric survey of three areas in East Africa is described. The survey was undertaken by the United Kingdom Atomic Energy Authority in 1958. The main patterns of radioactivity over the survey areas are summarized. (auth)

2875 (CEA-1590) CARACTERISTIQUES PHYSICO-CHIMIQUES DES MINÉRAUX URANIFÈRES SUPERGÈNES. (Physico-Chemical Characteristics of Uraniferous Supergene Minerals). M. A. Semat. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 33p.

Transport and deposit conditions of uraniferous minerals are briefly described. The synthesis of crystallographic, physical, optical, and thermal properties permits defining the main characteristics of this mineralogical group. Tables to facilitate identification of the supergene uranium minerals are given on investigation by anion and cation; system, cleavages, cell parameters, interplanar spacings, refractive indices, optical bearings; classification by decreasing values of the most intense line of the powder diagram; diagram for the three higher interplanar spacings; and diagram of the refractive indices. (auth)

2876 (RME-135) GAMMA-ONLY ASSAYING FOR DISEQUILIBRIUM CORRECTIONS. J. H. Scott and P. H. Dodd. Grand Junction Operations Office. Production Evaluation Div., AEC. Apr. 1960. 21p. OTS.

Most radiometric devices commonly used in mines or field locations to determine the grade of uranium ore are sensitive only to γ rays, and they are often calibrated to uranium ore in equilibrium. Equilibrium determinations, however, usually have been based on comparisons of chemical assays with radiometric assays made with laboratory equipment sensitive to both γ and β rays; errors thus result from differences in β-ray sensitivity of the field and laboratory radiometric instruments. In order to eliminate such errors a procedure was devised for γ-only assays in the laboratory. After the samples are pulverized, they must be sealed in order to restore radium-radon equilibrium after loss of radon gas by emanation. Some 20 to 30 days are required for the sealed sample to regain equilibrium, but the assay can be completed in only a few days by use of a radon-loss correction formula in conjunction with the procedure here described. A corollary formula is presented for determining initial percentage loss of radon by emanation from pulverized samples sealed for assaying. A nomograph was devised to facilitate control of statistical errors inherent in the computation of assays from radiometric data, and tables were developed to facilitate the assay computations and also corollary computations of initial percentage radon emanation. (auth)

2877 (RME-4526) RECONNAISSANCE FOR URANIUM IN THE SALAMANCA AREA, PROVINCE OF COQUIMBO, CHILE. Paul H. Knowles, William A. Bowes, Erik Klohn H., and Mario Serrano C. Division of Raw Materials, AEC, and Chile. Instituto de Investigaciones, Geológicas, Santiago. July 1958. 14p. OTS.

In June 1958, geologists of the USAEC and the Instituto de Investigaciones Geológicas de Chile (Instituto) made a reconnaissance for uranium in the Salamanca area, southeast of Illapel, Chile. The area was chosen on the basis of a known uranium occurrence in the Jarilla district and its geologically favorable location near the margin of a small acidic intrusive. No significant radioactive anomalies were found. The area does not warrant further investigations for uranium deposits at the present time owing to the lack of adequate structures for the passage of uranium solutions, the lack of a suitable host rock, and the lack of a low-temperature suite of minerals. (auth)

2878 (TEI-763) ANALYSES OF GROUND WATER FROM RAINIER MESA, NEVADA TEST SITE, NYE COUNTY, NEVADA. Alfred Clebsch, Jr., and F. B. Barker. Geological Survey, Washington, D. C. May 1960. 23p. OTS.

As part of the hydrologic studies being conducted at the Nevada Test Site, samples of ground water were collected from wells, springs, and tunnel workings. The sampling is aimed at determining the chemical quality of ground water at the test site, establishing the natural or background levels of radioactivity of the aquifers sampled, and defining the extent of explosion-produced radioactivity in the ground water in the vicinity of the blasts. (W.L.H.)

2879 (TEI-767) GEOLOGIC SECTION FROM CARLSBAD CAVERNS NATIONAL PARK THROUGH THE PROJECT GNOME SITE, EDDY AND LEA COUNTIES, NEW MEXICO. J. B. Cooper. Geological Survey, Washington, D. C. 1960. 1p. OTS.

2880 (AEC-tr-4187) SEDIMENTARY URANIUM DEPOSITS IN FRANCE AND THE FRENCH UNION. Translated from Bull. inform. Sci. et tech. No. 16, 2-8(1958). [Part] II. ibid. No. 17, 11-28(1958). [Part] III. ibid. No. 18, 22-30(1958). [Part] IV. ibid. No. 19, 16-31(1958). I. F. Kervella. 67p. JCL or LC.

Also issued in French as CEA-911.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract Nos. 7629, 7630, and 7631.

2881 (NP-tr-498) ON THE NATURE OF BALL LIGHTNING. G. I. Kogan-Beletskiĭ. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment) from Priroda 46, No. 6, 71-3(1957). 7p. JCL or LC.

Observations concerning the behavior of ball lightning are discussed. Cases of incidence of the ball on aircraft as observed by aircrews are examined. (J.R.D.)

2882 A PULSED NEUTRON SOURCE USED IN STUDIES ON OIL BOREHOLES. B. G. Erozolimskiĭ, A. S. Shkol'nikov, and A. I. Isakov. Atomnaya Energ. 9, 144-5 (1960) Aug. (In Russian)

Thermal-neutron age was measured in models filled with sand and paraffin or sand, paraffin, and salt. A BF_3 proportional counter was used for detecting thermal neutrons; pulses from the counter were transmitted to a 100-channel time analyzer. A tritium target served as a 14-Mev neutron source giving pulses 5 μsec long at 300 Hertz. The results show that oil-bearing models differ tenfold from water-carrying strata at t = 800 μsec. The count rate in pure sands with a mean fast-neutron flux of ~10^6 neutrons/sec was ~10 cpm/20-μsec channel at t = 800 min. (R.V.J.)

2883 ELECTRON AND PHOTON BEAMS AS MEANS OF DELINEATING OIL-BEARING AND WATER-BEARING STRATA. V. I. Gomonaĭ, I. Yu. Krivskiĭ, N. V. Ryzhkina, V. A. Shkoda-Ul'yanov, and A. M. Parlag. Atomnaya Energ. 9, 313-15(1960) Oct. (In Russian)

The water and oil bearing layers may be delineated in well logging by analyzing the (γ,n) reaction energy thresholds of isotopes composing the layers. The photoneutron yields from (γ,n) reactions in deuterium, C^{12}, C^{13}, and O^{16} are plotted. (R.V.J.)

2884 GEOPHYSICAL PROSPECTING SURVEY IN YASAKA AND DŌDANI MINES, YAMAGUCHI PREFECTURE. Kihei Shibatō and Yoshio Horikawa. Chishitsu Chosasho Geppo 11, 1-10(1960) Jan. (In Japanese)

Electrical and radiometrical prospecting surveys for uraniferous copper chlorite veins in granite were carried out at Yasaka and Dōdani mines, Yamaguchi prefecture. The indications of spontaneous polarization and resistivity methods are unsuitable for these thin veins, therefore, a special current-potential method in which the ore vein was taken as one electrode, was used. In the Yasaka mine high count anomalies were found in adit level by the radiometrical survey, and the current-potential method also seems to be useful for tracing the veins. In the Dōdani mine radioactive anomalies were not so large as those of the Yasaka mine in adit level. The current-potential method seems to be more applicable to low radioactive anomaly veins. (auth)

2885 RECONNAISSANCE SURVEY ON RADIOACTIVITY OF THE PALEOGENE SEDIMENTARY ROCKS IN THE SOUTHERN PART OF THE IIZUKA DISTRICT, CHIKUHŌ COAL FIELD, FUKUOKA PREFECTURE. Haruo Nagahama. Chishitsu Chosasho Geppo 11, 11-16 (1960) Jan. (In Japanese)

The surveyed area is located at the central part of Fukuoka prefecture in northwestern Kyūshū. Special attention was given to the Paleogene sedimentary rocks overlying the granitic rocks and the Paleozoic formations. The Paleogene sedimentary rocks are divided into five formations in ascending order as follows: the Oyake formation, the Sanjaku-goshaku formation, the Taketani formation, the Uwaishi formation, and Ideyama formation. Surface examination using a portable Geiger counter indicated no remarkably abnormal radioactivity in the surveyed area. The average degree of anomalous radioactivities of the formations ranged from 1.18 to 1.37 times greater than the value of the background count. On the other hand, that of anomalous radioactivity of the basement granitic rocks was 1.81 times greater than the value of the background count. It was found that the average degree of anomalous radioactivities of conglomerate and sandstone is greater than those of other sedimentary rocks in Tertiary formation. (auth)

2886 REPORT ON THE URANIUM DEPOSITS IN THE NAEGI DISTRICT, GIFU PREFECTURE. PART III. KŌKETSUYAMA AND NISHIŌBORA AREAS. Tadao Hamachi and Masami Tani. Chishitsu Chosasho Geppo 11, 34-40(1960) Jan. (In Japanese)

Gravel, pebble, and sand beds in the Kōketsuyama and Nishiōbora areas in Fukuoka-mura, Ena-gun, Gifu prefecture were surveyed for uranium deposits. The quartz-porphyry gravels and pebbles in the Kōketsuyama area are chiefly derived from the Tertiary formation (Pliocene) which is distributed in that area but not in the Nishiōbora area. The main constituent heavy minerals are ilmenite, cassiterite, and radioactive minerals such as monazite, endlite, naegite, and fergusonite, which are also common in the other areas of the Naegi district. The quantitative proportion of each heavy mineral is different in each area. The abnormal abundance of ilmenite is characteristic in the Kōketsuyama area. (auth)

2887 REPORT ON THE RECONNAISSANCE FOR URANIUM-BEARING ROCKS IN THE FUKUOKA COAL FIELD, KYŪSHŪ. Hiroshi Kamishima and Minoru Sasaki. Chishitsu Chosasho Geppo 11, 41-4(1960) Jan. (In Japanese)

In a survey carried out in February 1957, with a Philips "Pocket Battery Monitor," the radioactivities of several types of rocks were measured. The rock count divided by the background count is given for the following: aplite in the granodiorite of the Itojima type (3.7), alluvial mudstone (1.9), alluvial sandstone (1.6), granite of the Sawara type and granodiorite of the Itojima type (1.3), and rocks and coal of the Paleogene (≦1.0). (auth)

2888 MEASUREMENT OF THE AGE OF ONE OF THE VOLCANIC FLOWS PUY-DE-LA-VACHE (PUY-DE-DOME) BY THE CARBON-14 METHOD. Henri Pelletier, Georgette Delibrias, Jacques Labeyrie, Marie-Thérèse Perquis, and Aimé Rudel. Compt. rend 249, 2221-2(1959) Nov. 23. (In French). (CEA-1464)

Coatings of volcanic lava on the surrounding land provide ideal conditions for dating the corresponding eruptions by the C^{14} method. The great eruption of Puy-de-la-Vache, in Auvergne, has been dated in this way; the result found was 5690 (±350 years) B. C. (auth)

2889 OXIDATION OF SULFIDE ORE BODIES. 1. GEOCHEMICAL ENVIRONMENTS IN TERMS OF Eh AND pH. Motoaki Sato (Harvard Univ., Cambridge, Mass.). Econ. Geol. 55, 928-61(1960).

The probable ranges of oxidation potential and pH values for the weathering environment and those for the depth environment were studied through three approaches, namely field measurements of Eh and pH values of natural waters in mining districts, experimental oxidation of iron and manganese solutions by air, and theoretical considerations of chemical and mineralogical factors involved in natural systems. The oxidation potential for the weathering envi-

ronment is found to be largely controlled by the reduction mechanism of oxygen. Hydrogen peroxide forms during the reduction of oxygen in aqueous solution, and is catalytically decomposed back to oxygen plus water by various elements, some of which are common in natural systems. A reversible equilibrium is thus established between hydrogen peroxide and oxygen, resulting in the control of the oxidation potential of the weathering environment by the $H_2O_2-O_2$ couple. The oxidation potential for the depth environment is probably controlled by oxidation-reduction reactions involving iron-rich minerals, since iron is the most common among the elements that occur in more than one state of oxidation in rocks. Limitations may be imposed on the pH values for these environments by the dissociation of ferric hydroxide at the acidic side, and by the hydrolysis equilibrium of calcite at the basic side. An Eh-pH diagram indicating the probable ranges of Eh and pH values for the two environments is given. (auth)

2890 OXIDATION OF SULFIDE ORE BODIES. II. OXIDATION MECHANISMS OF SULFIDE MINERALS AT 25°C. Motoaki Sato (Harvard Univ., Cambridge, Mass.). Econ. Geol. 55, 1202-31(1960) Sept.-Oct.

Measurements of the single electrode potentials of sulfide minerals backed with basic understanding of their electrode behavior make it possible to clarify their oxidation or reduction mechanisms. The electrode potential of a sulfide mineral is controlled by the first-step reaction of the oxidation mechanism for the sulfide in an oxidizing solution, and by that of the reduction mechanism in a reducing solution. Sulfides of copper, lead, silver, iron, and zinc were studied. The results indicate that the direct oxidation of a simple sulfide mineral is a process in which the metal atoms move into the surrounding solution to become aqueous cations, accompanied by a step-wise decrease in the metal to sulfur ratio of the remaining solid phase. When solid sulfur is finally left over, it undergoes a series of reactions to be oxidized to sulfate ion. In case of reduction, sulfur atoms move out into the solution to become aqueous sulfide ions with a step-wise increase in the metal to sulfur ratio of the solid phase. To illustrate, the oxidation of chalcocite proceeds as $(Cu_2S) \rightarrow {}^1/_5(Cu_9S_5 + Cu^{2+})? \rightarrow (CuS + Cu^{2+}) \rightarrow (2Cu^{2+} + S)$. The path of the step-wise oxidation is not necessarily the same as that of the step-wise reduction for a metal-sulfur system. In the case of disulfides of iron, namely pyrite and marcasite, ferrous ions and S_2 molecules appear to be released simultaneously upon oxidation. (auth)

2891 CHEMICAL CHARACTERISTICS OF DAVIDITE. J. R. Butler and Rosemary Hall (Imperial Coll., London). Econ. Geol. 55, 1541-50(1960) Nov.

Twelve davidites from several localities and of different parageneses were analyzed for uranium and individual rare earths. The abundance of the total lanthanons invariably exceeded that of yttrium and the distribution of the individual lanthanons was strikingly similar for all specimens. Both the heavy and light lanthanons were more abundant than the middle lanthanons. Lanthanum generally exceeded cerium and may exceed the sum of the remaining lanthanons. (auth)

2892 A GRAPHICAL METHOD FOR CALCULATING THE TRUE VALUE OF A MINERAL DEPOSIT TRAVERSED BY A DRILLING. J. Bonnet and J. Sarcia. Mines et mét. No. 6, 355-7(1959) Mar. 20. (In French) (CEA-1355)

The reconnoitering of metal deposits, particularly uraniferous, by drilling is becoming of increasing importance. Considerations of cost on the one hand and the desire for precision of interpretation on the other are leading geologists to modify and perfect their method of work as a function of these factors. With a view to simplifying the job of technicians in charge of such work, a graph is presented which is simple to use and which allows the actual value of a formation traversed by drillings to be determined very quickly and with an excellent approximation from classical data. (auth)

2893 SULPHUR ISOTOPIC VARIATIONS IN NATURE. PART 7. SULPHUR ISOTOPIC MEASUREMENTS ON SULPHUR AND SULPHATES IN NEW ZEALAND GEOTHERMAL AND VOLCANIC AREAS. T. A. Rafter (Department of Scientific and Industrial Research, Lower Hutt, N. Z.), I. R. Kaplan and J. R. Hulston. New Zealand J. Sci. 3, 209-18(1960) June.

Sulfur isotopic measurements were made on a series of sulfur samples from New Zealand geothermal and volcanic areas. The average S^{32}/S^{34} ratio for fourteen geothermal sulfur specimens is 22:13. This is significantly lower than the average for twenty volcanic specimens from White Island whose average S^{32}/S^{34} ratio is 22:36. A smaller number of geothermal and volcanic sulfur samples from New Guinea show the same trend. Twelve specimens were examined in which sulfate-sulfur and sulfur were in intimate association. Wide variations in sulfur isotopic ratios were observed. These variations were correlated with the biogeochemical history of the specimens. (auth)

2894 SULPHUR ISOTOPIC VARIATIONS IN NATURE. PART 8. APPLICATION TO SOME BIOGEOCHEMICAL PROBLEMS. I. R. Kaplan (Commonwealth Scientific and Industrial Research Organization, Cronulla, New South Wales), T. A. Rafter, and J. R. Hulston. New Zealand J. Sci. 3, 338-61(1960) June.

Measurements of stable sulfur isotope ratios are used to explain some biogeochemical problems in nature. Laboratory experiments with bacteria included: bacterial sulfate reduction, bacterial chemosynthetic oxidation of sulfur and hydrogen sulfide, bacterial photosynthetic oxidation of sulfide, and an artificial sulfur spring. Results obtained from these experiments were used to interpret measurements made on natural environments from which sulfur compounds could be isolated and the ecology of which was studied previously. The environments investigated were the Cyrenaican Lakes, North Africa; the sulfur nodules of Lake Eyre, South Australia; sulfur from Kona, Masulipatam, east coast of India; a natural sulfur spring at Waipara, North Canterbury, New Zealand; the sulfur cycle in some Australian sewage plants; and mud and sea water from Milford Sound (a fjord), New Zealand. Bacterial sulfate reduction and chemosynthetic oxidation of sulfides gave enrichment in the lighter isotope (S^{32}) in laboratory experiments. Preliminary work with other bacterial steps in the cycle did not show any conclusive pattern of isotope fractionation. Measurements of naturally occurring deposits gave conflicting results. In some cases (e.g., Milford Sound) the explanation of the S^{32}/S^{34} ratios was relatively straight-forward; in others, no explanation could be offered for the apparently anomalous results. (auth)

2895 HUMIDITY EFFECTS ON EMANATION. V. I. Baranov and A. P. Novitskaya. Radiokhimiya 2, 485-90 (1960). (In Russian)

An increase of emanation in humid air as compared to dry air was observed with uraninite, samarskite, and xenotime specimens. The same effect was noticed during tho-

rium and radium evaporation from glass or pumice surfaces. It is postulated that the observed phenomenon is caused by a liquid film formed on the surface of the emanating material. (R.V.J.)

HEALTH AND SAFETY

2896 (A/AC.82/G/L.389) LOCAL CHANGES IN ^{90}Sr DEPOSITION IN THE SOIL AS OBSERVED IN HOKKAIDO ISLAND, JAPAN. Sanshi Abe, Yutaka Ueno, and Tadashi Yamaguchi. Hokkaido Univ., Sapporo, Japan. Medical School. May 1960. 8p.

A report is made on the Sr^{90} content of surface soils on Hokkaido Island, Japan in 1958 and 1959. Considerable variation with climatic conditions and soil characteristics was found. Several correlations between rainfall and Sr^{90} levels are established. (T.R.H.)

2897 (A/AC.82/G/R.166) MEASUREMENTS ON THE RADIATION FIELDS IN THE MONAZITE AREAS OF KERALA IN INDIA. D. S. Bharatwal and G. H. Vaze. India. Atomic Energy Establishment, Trombay. [Feb. 3, 1958]. 7p.

The Kerala State in India is noted for its monazite sand beaches. In this survey attention was focused on living quarters. The radiation in a total of about 200 houses was sampled at random in order to obtain data for a total area of approximately 250,000 square yards. The instrument employed in the survey was an ionization-chamber type milliroentgen meter. The measurements were undertaken in order to obtain experimentally the average γ field to which an individual residing in these areas is being subjected. It was found that the total $\beta + \gamma$ field was 1500 mrad per year. (W.L.H.)

2898 (A/AC.82/R.86/Add. 2) ENVIRONMENTAL CONTAMINATION FROM TESTS OF NUCLEAR WEAPONS. United Nations. Secretariat. July 14, 1960. 85p.

A brief review is given of current ideas concerning the mechanism by which radioactive aerosols are transferred from the stratosphere to the troposphere. Emphasis is placed on analysis of physico-meteorological processes causing this transfer and adding to the latitudinal distribution of radioactive contamination of soils in both hemispheres. An attempt is made to relate location of test sites to global fall-out distribution from the stratosphere. The stratospheric residence time of radioactive aerosols from autumn detonations at northern and polar latitudes is shorter than that for equatorial bursts. Explanations are offered for phenomena such as seasonal fluctuations of intensity of stratospheric fall-out. Most of the conclusions are based on solar heating of stratospheric aerosols, a hitherto neglected factor. (T.R.H.)

2899 (A/AC.82/R.86/Add.3) ENVIRONMENTAL CONTAMINATION FROM TESTS OF NUCLEAR WEAPONS. United Nations. Secretariat. Aug. 24, 1960. 153p.

Reports are given on mechanism of deposition of radioactive aerosols on soil from ground-level layers of air, concentration of fission-fragment radioactivity in ground-level layers of atmosphere, isotopic composition of fission-fragment mixture in surface layers of atmosphere, wet fall-out of radioactive aerosols on the ground, deposition of aerosol particles by raindrops and snowfall, fission-fragment activity in river and lake water, soil capture of aerosols from ground-level air, and levels of Sr^{90} in soils at the end of 1959. (T.R.H.)

2900 (A/AC.82/R.103) COMPUTATIONS OF DOSE FROM VARIOUS SOURCES OF RADIATION. United Nations. Secretariat. July 26, 1960. 76p.

Dose computations from fall-out are described and the parameters involved are discussed. Two assumptions are made to limit the variables: for external γ dose to any organ the population average is the individual dose; for internal γ or β dose an instantaneous equilibrium is reached between concentration of fission products in organs and in diet. Dose computations due to reactor accidents and occupational exposure are also considered. (T.R.H.)

2901 (A/AC.82/R.105/Add.1) TRITIUM FROM NUCLEAR TESTS. United Nations. Secretariat. July 13, 1960. 6p.

A brief review is presented on natural and artificial tritium in nature. The discussion includes the natural production rate and concentration, artificial concentration, radiation dose to soft tissue, and biological effects. (17 references). (T.R.H.)

2902 (AERE-HP/R-1426) THE ESTIMATION OF THE NEPTUNIUM CONTENT OF DUST COLLECTED FROM NUCLEAR EXPLOSIONS. N. G. Stewart and H. J. Gale. Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England. Apr. 22, 1954. Decl. June 17, 1960. 22p.

The gross decay curve of the radioactive dust from an atomic-bomb explosion generally differs from that of fission products alone in the first twenty-five days after burst because of the presence of U^{239} (23.5 m) and Np^{239} (2.33 d), which occur as the by-products of a conventionally designed bomb. Two independent methods, each based on certain assumptions concerning the statistical properties of mixed fission products, are given for calculating the relative Np^{239} and fission-product β activity in a dust sample at times when no U^{239} is present. A practical example is worked out in detail to illustrate the application of the two methods and the measure of agreement between them; in this case it is shown that at four days after time of burst, the Np^{239} is responsible for 74% of the β activity of the dust sample. The analytical methods can be used to determine the amount of any other active isotope mixed with gross fission products, provided that the basic conditions specified are satisfied. (auth)

2903 (CEA-1519) MESURES JOURNALIERES DE LA RADIOACTIVITÉ NATURELLE ET ARTIFICIELLE DANS L'AIR. (Daily Measurements of Natural and Artificial Atmospheric Radioactivity in 1959). J. C. Philippot. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 29p.

Daily numerical results of measures concerning β activity of the air, either natural, owing to thoron, or artificial, owing to active-aerosol origin, are given. The results are expressed in $\mu\mu$curie/m^3 of air. Procedures and standardization techniques are not described. (auth)

2904 (HW-52734) RADIOACTIVE DECONTAMINATION OF THE 60 TON OVERHEAD CRANE IN A SEPARATIONS FACILITY. G. C. Loud and A. J. Low. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Aug. 26, 1957. 12p. OTS.

A crane decontamination program, incorporating new cleaning and personnel exposure control techniques, was employed to achieve a significant reduction in radiation levels on the crane within a two-week period. As a result of this program, crane-catwalk time limits that prior to cleaning ranged from less than 30 sec to 6 min were increased to 10 to 20 min. The principle decontaminating agent was an organic solvent, inhibited 1,1,1-trichloroethane (methyl chloroform, CH_3CCl_3). The use of a spray-gun assembly, through which compressed air at 25 psi was introduced to the solvent stream near the spray nozzle, in-

creased the effectiveness of the solvent-spray method, particularly on oily surfaces and in cracks and crevices. Dosage Rate Integrators, manually operated electronic timekeeping devices, were used in conjunction with closed circuit television. This combination provided an exposure control system which conserved personnel exposure in certain phases of the work and made it possible to utilize the men more effectively in their decontaminating efforts. (auth)

2905 (NARF-60-10T) FISSION PRODUCTS FIELD RELEASE TEST—II. Convair, Fort Worth, Tex. Sept. 1960. 391p. Project No. 7809. Contract AF33(600)-38946. (AFSWC-TR-60-26; FZK-9-149).

The second in a series of experimental field programs for investigating the release, environmental dispersal, and biological effects of fission products was conducted at the Dugway Proving Ground, Utah, during the summer and fall of 1959. Eleven release experiments were performed in which metallic ANP type fuel elements were melted in high-temperature induction furnaces to simulate the slow meltdown and release of fission products accompanying a nuclear-propulsion-system reactor accident. Eight releases were made to the atmosphere under strong meteorological inversion conditions, and the fission products were allowed to disperse onto an instrumented sampling network extending 20 miles downwind from the release point. Three releases were made into collectors designed to collect 100% of the released fission products. The procedures and techniques employed in measuring deposition velocities, release percentages, and long-range diffusion parameters are described. Experimental results are presented, and interpretative comments are made with respect to improvements in the predictability of environmental contamination resulting from a reactor meltdown accident. (auth)

2906 (NP-9019) RADIOACTIVE CONTAMINATION IN FISHERIES PRODUCTS. Report of Sub-Committee III. Food and Agriculture Organization of the United Nations, Rome. 1959. 22p.

A discussion is presented on radioactive contamination of fisheries products. The present level of contamination of the sea, fresh-water bodies, and fisheries products and the contribution of radionuclides in fisheries products to human diet are indicated. Estimates of future contamination are made, and existing and potential sources of radionuclides from peaceful uses of atomic energy are evaluated. Finally, a general approach is presented to the problem of evaluation of the capacity of the marine environment to receive radioactive materials. Areas for research are recommended. (T.R.H.)

2907 (NP-9357) RADIOESTRONCIO EN LA LECHE. INFORME NO. 47. (Radiostrontium in Milk. Report No. 47). D. Beninson, J. Kramer, and E. Mariano. Argentina. Comisión Nacional de Energía Atómica, Buenos Aires. 1960. 8p.

Among the radionuclides produced in nuclear explosions, Sr^{90} is the most outstanding as a potential biological hazard. Studies were made of the Sr^{90} in consumer's milk since Oct. 1959 in Buenos Aires and compared with values for New York. A relation between fall-out and milk contamination was deduced, and the effects on the population discussed. (T.R.H.)

2908 (NYO-2855) SAMPLING OF THE UPPER ATMOSPHERE FOR PARTICULATE MATTER. Final Report, Phase I. Michael Markels, Jr. Atlantic Research Corp., Alexandria, Va. Aug. 1960. 43p. Contract AT(30-1)-2404. OTS.

The feasibility of various methods for collecting particulate matter in the upper atmosphere was investigated. A theoretical investigation showed that a descending rotor-chute with five rotating blades, each 14 ft long and containing five impactors per blade for sample collection, can sample over 2000 standard cu ft of air in descending from 200,000 to 100,000 ft. It can remove particles as small as 0.01 μ with a calculated efficiency of 80% or better. A variable rotor-tip speed during descent can be used if the extra convenience and ease of interpretation provided by equal sampling per unit mass of air are desired. The calculated sample sizes obtained by rotorchute are over 10 times as great as for any other system studied. The 40-lb payload required for this size sample, which includes rotor blades, impactors, hub, controllers, and telemetering equipment, can be sent to 200,000 ft by an Arcon rocket developed by Atlantic Research Corporation for an estimated cost of $6000 to $8000 per flight for purchased items. The feasibility of using a rocket vehicle to obtain the required sample is demonstrated by this study. It is recommended that the design and development of an operating sampler be initiated. (auth)

2909 (ORNL-2777) APPLIED HEALTH PHYSICS ANNUAL REPORT FOR 1958. Oak Ridge National Lab., Tenn. Nov. 18, 1960. 60p. Contract W-7405-eng-26. OTS.

After a discussion of permissible exposure levels, radiation and contamination control and responsibility for radiation protection, monitoring activities, and monitoring instruments are described. In Area Monitoring a statistical summary and monitoring details in tabular and graphic form are given. Personnel monitoring is reported, and assays and instruments are described. (T.R.H.)

2910 (SGAE-60/2 B) DIE RADIOAKTIVITÄT DER ABLUFT DES ASTRA BEI NORMALBETRIEB. (Radioactivity of the Waste Air from ASTRA for Normal Operation). Heinrich Bruneder. Österreichische Studiengesellschaft für Atomenergie G.m.b.H., Vienna. [1959]. 28p.

The total activity in the ventilation stack at ASTRA is calculated to be 1.6×10^{-4} c/m^3. The radiation doses at the operation building wall and at the reactor building produced by the ventilation stack are calculated. The effect of a weather inversion on the dose is shown in calculations for normal-weather and inversion-weather conditions. (T.R.H.)

2911 (TID-6235) RADIOACTIVE FALLOUT FROM NUCLEAR DETONATIONS OF FEBRUARY AND APRIL 1960. Alfred W. Klement, Jr. Division of Biology and Medicine. Fallout Studies Branch, AEC. June 24, 1960. 16p. OTS.

Data pertaining to fall-out from the French nuclear detonations of February and April 1960 are presented. (J.R.D.)

2912 (TID-6722) LETTER PROGRESS REPORT FOR MAY 1960. Rex C. Wood and S. P. Jones. General Mills, Inc., Minneapolis. July 5, 1960. 24p. Contract AT(11-1)-401. OTS.

Research activities aimed at improving aerosol-sampling methods for reduced pressures are reported. Previous test results indicate that the propeller type flowmeter is substantially independent of density at pressures equivalent to those at 50,000 to 90,000 ft. An operational version of this flowmeter is in the design phase. Development of an improved 40-Mc transmitter, consisting of a two-tube grid-modulated circuit which overcomes limitations found in some older models of this transmitter, is reported. Two completed transmitters are ready and scheduled for test-

ing. An analysis is included of past data showing that isotope-activity ratios and air-mass circulation patterns can be used to identify production origins of airborne debris. (J.R.D.)

2913 (TID-6886) UPPER ATMOSPHERE MONITORING PROGRAM. Progress Report No. 10 [for] November 1, 1959 through December 31, 1959. Report No. 2109. J. Baumstark, L. Graf, I. Hall, S. Jones, L. Torgeson, and R. Wood. General Mills, Inc., Minneapolis. Sept. 15, 1960. 24p. Project No. 89125. Contract AT(11-1)-401. OTS.

Experimental work on the focusing array impactor for collecting particulate matter in the upper atmosphere continued. Efficiency tests were conducted using an aqueous suspension of methylene blue aerosolized at reduced pressures. It was determined that this and similar methods are subject to errors of unknown magnitude and that previous values reported may be too high. The theoretical study of fibrous filters was extended to give a better approximation for Cunningham slip and the effect of interception as given by Davies. The mathematical derivation is presented along with experimental results. Research on the development of homogeneous aerosols less than 20 mμ in diameter continued. Difficulties encountered in the purification of viruses for use in filter efficiency determinations, especially S13 bacteriophage, are discussed. It was determined that any filter efficiency tests conducted must be done microbiologically. Two methods for determining the size of S13 bacteriophage using the electron microscope are described and the advantages given. The results of three balloon flights are described. Equipment on one flight malfunctioned. Data from the other two flights were used to calculate particle size and β activity per standard cubic foot. A plot of these and previous data are compared and discussed. (auth)

2914 (UWFL-63) FURTHER CONTRIBUTIONS ON GROSS BETA RADIOACTIVITY OF BIOLOGICAL AND RELATED SAMPLES AT THE ENIWETOK PROVING GROUND, 1952-1958. SECTION I. PHYSICAL DECAY OF SAMPLES FROM ENIWETOK ATOLL IN 1952. SECTION II. FURTHER CONTRIBUTIONS ON GROSS BETA RADIOACTIVITY OF PLANKTON AND BOTTOM SAMPLES AT RONGELAP ATOLL, 1954-1958. SECTION III. FURTHER CONTRIBUTIONS ON GROSS BETA RADIOACTIVITY OF FISHES AT RONGELAP ATOLL, 1954 THROUGH MARCH 1958. Kelshaw Bonham. Washington. Univ., Seattle. Lab. of Radiation Biology. Dec. 4, 1959. 47p. Contract AT(45-1)-540. OTS.

The pattern of radioactive decay over periods of about six years for 102 samples from Eniwetok Atoll and 2 sand samples from Nevada, are presented. Logarithmic plots commonly had slopes of from -1.2 to -1.8. The slopes for the last three years tended to be steeper and to show more variability than for the first three years. An exceptionally slow rate of decay prevailed for the last three years in a sample of rat muscle where Cs^{137} was almost the only radioisotope. Slow decays occurred in muscle, liver, bone, and kidney of various animals. Available data on plankton from Rongelap Atoll for 1954 to 1958 are brought together. Values based on wet weight as reported earlier, and also new values computed on the basis of ash weight of the sample are included. Mesh size did not influence activity levels of the plankton samples. For August 1958, the amount of activity in 10 pumped plankton samples was shown not to be correlated with the activity of samples of lagoon bottom material taken at the same stations. The trends in the average activities of the liver, muscle, and bone of reef fish at Rongelap and Kabelle Islands and lagoon-pelagic fish of Rongelap Atoll are given for the period from 1954 through August 1958. Ultimate decline was to levels of about 0.005 μc per kilogram of wet tissue. (auth)

2915 (WSEG-RM-10 & Suppl.) AN ANALYTIC MODEL OF CLOSE-IN DEPOSITION OF FALLOUT FOR USE IN OPERATIONAL-TYPE STUDIES. George E. Pugh and Robert J. Galiano. Weapons Systems Evaluation Group, Inst. for Defense Analyses, Washington, D. C. Oct. 15, 1959. 162p. Supplement: REVISION OF FALLOUT PARAMETERS FOR LOW-YIELD DETONATIONS. George E. Pugh. 76p.

A fall-out model for calculating the distribution of activity with given wind conditions is described. The model differs from simplified models in that it employs as a variable the fall-out shear (rate of descent of the radioactive debris independent of the wind). A technique is presented for using statistical meteorological data to obtain a mean shear and the standard deviation of the shear. A biological effect relation is established between the distribution of activity and the biological damage done. Characteristic values of fall-out contours from 1 kt to 100 Mt explosions are presented in tabular form for both H + 1 dose rate and maximum biological dose. (C.J.G.)

2916 (A/AC.82/G/R.221) GONAD-DOSES IN DIAGNOSTIC RADIOLOGY. GENETICALLY SIGNIFICANT RADIATION DOSES FROM DIAGNOSTIC RADIOLOGY IN DENMARK. Erling Hammer-Jacobsen. Translated from Ugeskrift Laeger 119, 279-90(1957). 18p., 4 illus.

Measurements were made of the radiation dose to the gonads received by patients during diagnostic radiology procedures. The possibilities of reducing the radiation exposure by various methods was also investigated. (C.H.)

2917 (AEC-tr-3840) REALIZATION, PRESERVATION AND COMPARISON OF THE UNIT OF DOSE FOR ROENTGEN AND GAMMA-RADIATION WITH QUANTUM ENERGIES BETWEEN 3 AND 400 KEV. A MANUAL FOR THE DOSIMETRY OF STANDARDS. (Darstellung, Wahrung und Ubertragung der Einheit der Dosis für Roentgenund Gammastrahlen mit Quantenenergien Zwischen 3 keV und 400 keV. Richtlinien zur Standard-Dosimetrie). B. Rajewsky, E. Bunde, M. Dorneich, D. Lang, A. Sewkor, R. Jaeger, and W. Hübner. Translated by Harvey I. Israel (Los Alamos Scientific Lab.). Max-Planck-Institut für Biophysik, Frankfurt am Main and Physikalisch-Technische Bundesanstalt, Brunswick (City). 147p. OTS.

The employment of x and γ radiation in medicine, biology, physics, chemistry, and industry has necessitated a definition of the concept of dose and the creation of a unit of measurement. The present formulation of the concept and unit as presented in the recommendations of the International Committee for Radiologic Units requires that standard measuring apparatus for x and γ radiation should be built and compared. This manual was written with the idea of preparing the broadest possible reference for the practice of dosimetry of standards in the energy range of x and γ rays between 3 and 400 Kev. Measurements using primary standards, such as the cylindrical chamber, the parallel-plate chamber, and the total-absorption chamber, are compared with those using secondary standards and with national and international comparison measurements. An attempt was also made to collect and arrange all accessible information on construction of instruments, operation, methods of measurement, and evaluation of results of measurements. 301 references. (C.H.)

2918 (AEC-tr-3887) ATOM BOMB SHELTER. A Translation of "Abri Anti-Atomique," Feb. 20, 1959. Pierre Teissier. 20p. OTS.

Design criteria are presented for a reinforced-concrete personnel shelter to provide air-blast, seismic-shock, thermal, and radiation protection against an atomic explosion at a distance of 350 m or a thermonuclear explosion at a distance of about 1400 m from the point of detonation. (C.H.)

2919 (AEC-tr-3889) SPECIFICATIONS FOR RADIATIONPROOF SHELTERS. EFFECTIVE APRIL 1959. (Richtlinien für Strahlungssichere Schutzbauten. Fassung April 1959). Germany. Bundesministerium für Wohnungsbau, Bonn. Translation. 27p. OTS.

Specifications and requirements are given for shelters against explosive bombs, atomic bombs, ABC weapons, and incendiary weapons. Features specified are concerned with location, types, space requirements, structural parts and their dimensions, ventilation, water supply, electric equipment, building materials, erection, and equipment. (T.R.H.)

2920 (AEC-tr-3890) PRELIMINARY PROCEDURES FOR INSTALLATION OF VENTILATING SYSTEMS DURING THE RECONDITIONING OF PROTECTIVE BUNKERS. EFFECTIVE DECEMBER 1958. (Vorläufige Richtlinien für den Einbau von Belüftungsanlagen bei der Wiederinstandsetzung von Schutzbunkern. Fassung Dezember 1958). Germany. Bundesministerium für Wohnungsbau, Bonn. Translation. 18p. OTS.

Specifications or requirements are given for ventilating protective shelters. The factors considered include ventilation, filters, blowers, heaters, coolers, conduits, and emergency kitchens. (T.R.H.)

2921 (AEC-tr-3893) PRELIMINARY DIRECTIVES CONCERNING WATER SUPPLY AND DEWATERING IN THE RECONDITIONING OF PROTECTION BUNKERS. EFFECTIVE DECEMBER 1958. (Vorläufige Richtlinien für die Versorgung mit Wasser und für die Entwasserung bei der Wiederinstandsetzung von Schutzbunkern. Fassung Dezember 1958). Germany. Bundesministerium für Wohnungsbau, Bonn. Translation. 14p. OTS.

Specifications and requirements for water supply and dewatering systems for protective shelters are given. These include types, capacities, statistics on water consumption, piping, fittings, fixtures, tanks, pumps, and openings. (T.R.H.)

2922 (AEC-tr-4134) RADIOACTIVE FALLOUT OVER NORWAY FROM THE FRENCH ATOMIC WEAPON TEST IN SAHARA. (Radioaktivt Nedfall over Norge fra den Franske Atomvåpenpröve i Sahara). T. Hvinden. Norway. Forsvarets Forskningsinstitutt, Lilleström. Translated from report FFIF-F-0036, Mar. 1960. 10p. JCL or LC.

Increased fall-out levels were observed in Kjeller, Norway, which could be traced to the French atomic tests in the Sahara. Fall-out in Norway was to be expected from these tests, but it appears that the atomic cloud retained an unexpectedly large concentration. (T.R.H.)

2923 (JPRS-2624) INDIVIDUAL DOSIMETRY OF SOLDIERS IN AN ATOMIC ATTACK. Aleksandar Mezic. Translated from Vojnosanit. Pregled 16, 1015-22(1959). 19p. OTS.

The impact of atomic and thermonuclear weapons on medicosurgical tactics and on operative actions during future wars is discussed. Procedures for the dosimetry of soldiers are described. The management of military casualties due to atomic exposure is discussed. The need for training personnel before the outbreak of war is stressed. (C.H.)

2924 (JPRS-3418) THE PROBLEM OF RADIOLOGICAL PROTECTION. W. Zawadowski. Translated from Polski tygodnik lekarski No. 9, 326-30(1960). 13p. OTS.

Recommendations are presented for the evaluation of the hazards to the Polish people from radiation from all sources. Possible means for protection of the population against avoidable radiation are considered. (C.H.)

2925 (JPRS-6142) SPACE AND TIME VARIATIONS OF THE NATURAL RADIOACTIVITY OF THE ATMOSPHERE. S. G. Malakhov, G. S. Kirdin, A. V. Kovda, and T. I. Sisigina. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz. 698-706(1960). 16p. OTS.

Measurements of the natural radioactivity of the air near the earth were made at nine geographical points in Russia. The effects of various meteorological factors on the variation of natural radioactivity in the atmosphere were investigated. (C.J.G.)

2926 DETERMINATION OF THE OVARY DOSE IN DIAGNOSTIC ROENTGEN PROCEDURES. Finn Devik, Jon Flatby, and Leiv Berteig (Rikshospitalet, Oslo). Acta Radiol. 54, 296-304(1960) Oct. (In English)

The estimation of the ovary dose from diagnostic roentgen exposures by direct measurements in postmortem materials, in a phantom, and in indirect measurements in living subjects is discussed. The construction of the phantom that was developed is described. (auth)

2927 A PRIMER ON PRACTICAL WAYS TO COLLECT BERYLLIUM DUST. PART IV. A. J. Breslin and W. B. Harris (U. S. Atomic Energy Commission, New York). Air Eng. 2, No. 10, 48-50; 62; 64(1960) Oct.

Among the tools used in controlling airborne exposure to beryllium, the most effective were found to be rigid selection of process components, local exhaust ventilation at all points, very careful operating procedures, unusually good housekeeping, and frequent sampling of the atmosphere. Clean work clothes should be issued daily. Mops should be used in wet areas and vacuum cleaners in dry areas. Monitoring must be performed on a repititive basis in view of the changeability of dust concentrations in a plant. The fact that there are two distinct types of respiratory illness caused by beryllium, an acute and a chronic disease, creates the additional restriction that there be two different permissible levels, one based on long-term exposure and the other on a single short-term dose. (M.C.G.)

2928 EFFECT OF EXCESS CHELATING AGENTS ON RARE-EARTH DECONTAMINATION. Hiram E. Hart (Montefiore Hospital, New York and City Coll., New York). Ann. N. Y. Acad. Sci. 88, 486-97(1960) Aug. 18.

The affinity of chelating agents for heavy metals and the rare earths has motivated their study in stable and radioactive metal detoxification. In general it was found that metabolically inert chelating agents having strong metal affinities are effective in enhancing excretion of the unwanted metals. A series of yttrium chelates was injected intravenously at tracer levels to man, and the subsequent urinary excretion was studied. The doses consisted of 1 mg yttrium combined in a metal to chelate ratio of 1.0 to 1.2. When studying the effect of excess chelating agent, an attempt was made to inject the tracer and carrier in less than 10 min. The general procedures followed throughout this work closely parallel the techniques reported earlier by Hart et al. A theory involving coupled differential equations is proposed to explain the observed results. (B.O.G.)

2929 IONIZATION METHODS OF MEASURING THE ENERGY ABSORBED FROM A RADIATION FLUX CONSISTING OF NEUTRONS MIXED WITH γ-RAYS. Yu. I. Bregadze, B. M. Isaev, and V. A. Kvasov. Atomnaya Energ. 9, 126-31(1960) Aug. (In Russian)

The possibilities are analyzed of separately determining absorbed fast-neutron and γ energies in the mixed flux

from a reactor by means of an ionization chamber. Tests were made with three chambers of various content: polyethylene with ethylene admixture, graphite with CO_2 admixture, and aerion (conducting plastic filled with ethylene and CO_2). Theoretical calculations were made of the sensitivity to neutrons with energies from 0.2 to 8 Mev. Variations in the neutron spectra did not influence the precision of absorbed-dose determinations in water-carrying substrata. The order of error in determinations of the absorbed energy from fast neutrons is ~15%, and depends slightly on the neutron and γ dosage ratio. (tr-auth)

2930 DOSE DISTRIBUTION IN AN OBJECT MOVING IN THE FIELD PRODUCED BY A LINE SOURCE. U. Ya. Margulis, S. M. Stepanov, and V. G. Khrushchev. Atomnaya Energ. 9, 320(1960) Oct. (In Russian)

A formula was derived for determining the total dose in an object moving in the radiation field produced by a linear source. The dose was obtained for a point on a perpendicular set at the extreme end of a rod. The dose at any other point is equal to the sum or difference of the doses from corresponding linear sources. The formula holds true when the objects are so close to each other that the distances between them need not be considered. The formula also holds true for doses produced by rectangular plane sources which can be considered a system on n-linear sources. (R.V.J.)

2931 A SIMPLE CALORIMETRIC METHOD OF MEASURING THE DOSE RECEIVED FROM A POWERFUL SOURCE OF IONIZING RADIATION. M. B. Fivelskiĭ, Yu. S. Lazurkin, and M. A. Mokul'skiĭ. Atomnaya Energ. 9, 321-3(1960) Oct. (In Russian)

A nonstationary calorimetric method was developed for determining absolute doses in polymers, water, water solutions, glass, and biological objects exposed to reactors, strong γ sources, and x-ray tubes. Cylindrical specimens of polystyrene, polyethylene, and quartz 30 mm in diameter and 50 mm high were used in tests. The design of the dosimetric device is given and the changes in temperature, measured with thermocouples in the center of polyethylene in a reactor well, are plotted. The dosage distribution curves along channel 65 of the WWR reactor for polyethylene and quartz are plotted. (R.V.J.)

2932 EXTERNAL GAMMA-RAY DOSE RECEIVED FROM FALLOUT IN 1959. V. P. Shvedov, G. V. Yakovleva, and M. I. Zhilkina. Atomnaya Energ. 9, 323-4(1960) Oct. (In Russian)

Radioactive fall-out for 1958–1959 near Leningrad was analyzed by scintillation spectrometer. The data for 30-year dosage from external fall-out radiation were plotted on the basis of the number of active nuclei per m^2 of soil per day. The dose for 1959 is 19.2 mr which (due to stopping of the tests) is considerably smaller than the dose for 1958. (R.V.J.)

2933 INCREASE IN THE RADIOACTIVITY OF FALL-OUT AT HRADEC KRÁLOVÉ (CZECHOSLOVAKIA) AS A RESULT OF NUCLEAR TESTS IN THE SAHARA. V. Santholzer (Charles Univ., Prague). Atomnaya Energ. 9, 324-6(1960) Oct. (In Russian)

The results of measurements carried out from Nov. 1, 1956 to Mar. 31, 1960 (mμ c/liter) showed the highest rain water radioactivity on Mar. 6, 1960, 25.9 mμ c/liter. The time of the increased activity indicates the first Sahara nuclear test made Feb. 13 as the origin. Data from daily measurements of fall-out in March and April of 1960 are extrapolated with previous and later data. (R.V.J.)

2934 NEW HERMETICALLY SEALED CHAMBERS FOR WORKING WITH α AND β MATERIALS. G. N. Lokhanin and V. I. Sinitsyn. Atomnaya Energ. 9, 344-7 (1960) Oct. (In Russian)

Descriptions are given of new hermetically sealed enclosures designed for working with α and β active materials at high temperature. The enclosures are 2320 mm high, 1270 mm long, and 875 mm wide. The chambers are so constructed that one or two front compartments are available for working. (R.V.J.)

2935 THE RADIOACTIVITY OF ATOMIC ORIGIN OF THE AIR AND PRECIPITATIONS. Hubert Garrigue. Compt. rend. 251, 1645-6(1960) Oct. 17. (In French)

The artificial radioactivity of the air and especially of precipitations is still far from being negligible. The β activity of precipitations collected at the summit of Puy de Dome is measured monthly. The values obtained from May 1959 to August 1960 are tabulated. The measurements of the air were made from a plane. (J.S.R.)

2936 RESULTS OF THREE-YEAR SYSTEMATIC MEASUREMENT OF NUCLEAR FALL-OUT. V. Santholzer (Charles Univ., Prague). Czechoslov. J. Phys. 10, 595-602(1960). (In English)

A survey is given of the results of measuring the radioactivity of rain-out from Nov. 1, 1956, to Feb. 1, 1960, and of fall-out from Nov. 1, 1958, to Feb. 1, 1960. The temporary cessation of nuclear weapon tests from Nov. 1, 1958, became apparent in the second half-year after the cessation by a decrease in the cumulative activity to 45% of the value for the first half-year. At the end of 1959 another decrease was apparent. It was shown on the basis of long-term investigation into the activity that the samples of fall-out with greater activity contain relatively very little admixture from earlier nuclear tests so that in the period of a few weeks to months the sets of fission products may be regarded as practically isolated. The exponent n in the relation $A = at^{-n}$ is most frequently 1.2 for the period of the first four months and for older samples is most often $n = 1.5$. The energy of the β and γ rays from fall-out was estimated on the basis of absorption measurements. It was shown that the quality of the β radiation varies with the age of the samples. A brief survey is given of the results of determining the Sr^{90} content in fall-out and milk, and of the methods of physical evidence of Sr^{90} used. (auth)

2937 RADIOACTIVE FALL-OUT OVER SOUTH AFRICA. W. R. McMurray (National Physical Research Lab., C.S.I.R., Pretoria). Ind. Rev. Africa. Suppl. Atomics and Energy 12, No. 2, 70-8(1960) Aug.

The methods of sampling and measurements of fall-out over South Africa resulting from nuclear weapon testing are discussed. The rate of decay of mixed fission products is analyzed to enable a simple estimation of the effective age of a sample of unknown origin. The data are analyzed to obtain time and space distributions of radioactive fall-out across South Africa. The South African data are compared with similar information available from the Northern Hemisphere. The additional irradiation of genetic significance is derived from the measured accumulated environmental contamination and the extent of Cs^{137} ingestion. The latter is estimated from the related measurements of Sr^{90} deposition. (auth)

2938 TOTAL BODY RADIATION AND DOSE TO THE OVARIES FROM A THERAPEUTIC DOSE OF IODINE^{131}. H. E. Duggan, D. B. Scott, and Dorothy L. Weijer (Univ. of Alberta, Edmonton). J. Can. Assoc. Radiologists 10, 56-9(1959) Dec.

There is increasing interest in total-body radiation and dose to the gonads resulting from roentgen diagnostic procedures and from the use of radioisotopes. This report deals with the administration of a 9-mc dose of I^{131} for

hyperthyroidism to a 47-year-old female patient of height 5'1" and weight 33.4 kg. Estimates were made of total-body radiation (exclusive of dose to the thyroid) and the dose to the ovaries. The values obtained were 15 and 9 rads, respectively. Significant somatic damage is unlikely to result from this much total-body radiation, but the dose to the ovaries, which is chiefly of genetic significance, may be important. It is suggested that due regard should be taken for the possible genetic hazards in the therapeutic use of I^{131}. (auth)

2939 DETERMINATION OF CESIUM-137 IN MILK POWDER. L. Jeanmaire, H. Fourniguet, and G. Michon (Commissariat à l'Énergie Atomique, [Saclay, France]). Lait 39, 8p.(1959) Nov.-Dec. (In French). (CEA-1498)

A method is given for the determination of Cs^{137} in milk powder. The technique is based on γ spectrometry. The main difficulty consists in the calibration of the apparatus. With a sodium iodide crystal 20 cm in diameter and 10 cm high amounts of 40 $\mu\mu$c of Cs^{137} per gram of potassium can be measured with an accuracy of about 7% in a milk powder sample of 2.5 kg. This method has the advantage of being nondestructive. (auth)

2940 Sr^{90} AND Cs^{137} IN FALL-OUT AT ISPRA. A. Benco, P. Gaglione, A. Malvicini, and L. Vido (Centro di Studi Nucleari, Ispra, Italy). Minerva nucleare 4, 229-34(1960) Sept. (In Italian)

The values for Sr^{90} and Cs^{137} in fall-out collected monthly at Ispra are reported. It was found that the deposition of Sr^{90} and Cs^{137} in the Spring of 1959 was much greater than in the second half of 1959. Measurements of the decay and spectrometric analysis of fall-out indicated that the radioactivity of fall-out collected in the Spring of 1959 was almost entirely due to nuclear explosions in Oct.-Nov. 1958. It was observed that the mean residence time of Sr^{90} in the stratosphere is much shorter than was recently thought. A considerable increase in the radioactivity of some foods, especially milk, has been caused by the radioactive fall-out deposited in the Spring of 1959. The results of spectrometric analysis of milk ashes are reported. (auth)

2941 EVALUATION OF THE ABSORBED DOSE. A. Venier (Ente Nazionale per la Prevenzione degli Infortuni, Rome). Minerva nucleare 4, 235-9(1960) Sept. (In Italian)

The value of the dose actually absorbed with low and medium-energy x and γ rays is discussed. Effective evaluation of the dose actually absorbed by vital organs requires knowledge of the type of radiation used. Two main methods of mass dosimetry are considered. The values for the absorbed dose obtained with pocket ionization chambers (indirect reading), pocket dosimeters (direct reading), and sensitive films are examined comparatively. It is concluded that the film-dosimetric method with selective filtration is the best method, being the only dosimetric method capable of also indicating the qualitity of the radiations. (auth)

2942 THE POSSIBILITY OF REDUCING THE GENITAL DOSE ABSORBED IN PHOTOFLUOROGRAPHY OF CHILDREN. R. Dall'Acqua and A. Bigo (Ospedale Mauriziano, Turin). Minerva nucleare 4, 241-4(1960) Sept. (In Italian)

In order to obtain the greatest possible reduction in the dose absorbed by the sex organs in young patients during photofluorography with normal apparatus suited for adults, the use of special reductors appliable at the base of the limitator cone of the radiogenous beam, with consequent reduction of the field illuminated on the fluorescent screen, was investigated. In a series of tests it was found that these accessories reduce the absorbed dose about 1/6 in patients aged 3, 6, and 10 years, respectively. With the use of these practical accessories, other protective measures, such as lead screens applied at the height of the iliac bones, seem useless. (auth)

2943 CONSIDERATIONS ON THE USUAL DOSES OF I^{131} IN TEST ON THYROID UPTAKE IN CHILDREN. C. Imperato, G. Giovannelli, F. D. Battistini, and G. Ghirardini (Università, Parma, Italy). Minerva nucleare 4, 244-7(1960) Sept. (In Italian).

In view of the international maximum permissible dose of radiations of 0.05 rep per 24 hr, an appraisal was made of the usual doses of I^{131} used in performing thyroid function tests in children (1 μc per kg of body weight). On the basis of the physical characteristics of I^{131} and of anatomical and functional data concerning the thyroid gland in children, it was concluded that tests with radioiodine, as usually performed, are a cause of much greater irradiation of the gland than the permissible degree of irradiation based on the above tolerable dose. In order to avoid excessive irradiation, the use of an iodine isotope with a shorter half-life (I^{132}) was considered. The results of personal studies contact with the technique were presented. Owing to the improvements in measuring apparatus, values for the uptake and urinary excretion of I^{131} were obtained with this technique which were in agreement with previous researches in this field using a total dose of 0.2 to 0.3 μc in children aged 5 to 11 years. (auth)

2944 METHOD FOR THE DETERMINATION OF Cs^{137} AND Sr^{90} IN BIOLOGICAL SAMPLES. C. Tribuno, P. Cacciari, and G. Garagnani (AGIP Nucleare, Milan). Minerva nucleare 4, 255-62(1960) Oct. (In Italian)

Experimental methods used to obtain very low β and γ backgrounds and analytical chemical methods for the quantitative determination of Cs^{137} and Sr^{90} contained in biological samples (soil and milk), fall-out, and atmospheric dust are presented. (auth)

2945 GAMMA SPECTROMETRY IN THE DETERMINATION OF RADIOACTIVE CONTAMINATION OF FOODS. P. Gaglione, A. Malvicini, and L. Vido (Centro di Studi Nucleari, Ispra, Italy). Minerva nucleare 4, 262-7(1960) Oct. (In Italian)

A scintillation counter especially suited for γ spectrometry of low-level activity samples is described. The geometrical placement of the sample makes it possible to obtain a high value for the total counting rate as compared with the background. Some spectra obtained directly with samples of milk, powdered milk, and other food samples are presented. The specific activity of the sample is deduced directly from the area of the photoelectric peak and from the efficiency of the detector. (auth)

2946 DETERMINATION OF Sr^{90} IN SURFACE WATERS. C. Gandino, A. Malvicini, and L. Vido (Centro di Studi Nucleari, Ispra, Italy). Minerva nucleare 4, 268-71(1960) Oct. (In Italian)

A method for measuring the concentration of Sr^{90} in surface waters is described. The values for Sr^{90} content in underground waters, in lakes near the Ispra Nuclear Studies Center, and in drinking water in Varese and Milan are reported. It was observed that the Sr^{90} concentration in water from Lake Maggiore was less than in water from small lakes but was greater than in underground water. The value for the Sr^{90} concentration in the water of some lakes was almost equivalent to the maximum permissible concentration for drinking water for the general population. (auth)

2947 MEASUREMENTS OF CAESIUM-137 IN HUMAN BEINGS DURING 1958-59. G. Maycock, Sheila W. Terry, J. Vennart, and M. E. Wise (Radiological Protection Service, Belmont, Sutton, Surrey, Eng.). Nature 188, 355-7 (1960) Oct. 29.

Measurements of Cs^{137} content were made in all persons referred for measurement of their body radioactivity, beginning in Jan. 1958. The largest group of these people comprised women who had worked in the radium-luminizing industry. Measurements were made on 203 of the luminizers, 182 females and 21 males. Measurements were made for Cs^{137}, K^{40}, and radium by detecting their γ energies and comparing the spectrum for each subject with that from calibration sources. From these measurements, it was determined that the mean annual dose received by those measured, from Cs^{137} in the body, was less than 2% of that from natural sources, which is ~100 mrem/year. (B.O.G.)

2948 GAMMA RADIATION FALL-OUT. MEASUREMENT WITHIN BUILDINGS. Nuclear Energy, 419-20(1960) Sept.

A method for calculating fall-out γ radiation intensities within structures was developed at the National Bureau of Standards. The intensity within a structure depends chiefly on barrier and geometrical attenuation. For very thin walls, the intensity is obtained as the barrier factor times geometry factor for direct radiation. For very thick walls, the intensity equals the barrier factor times the geometry factor for scattered radiation. For walls of intermediate thickness, the intensity from both direct and scattered radiation must be calculated. (M.C.G.)

2949 RADIATION SAFETY AND CONTROL. III. PROBLEMS OF CONTAMINATION HAZARDS. THE PROVISION OF NECESSARY SAFEGUARDS. A. R. Gould (Royal Military Coll. of Science, Swindon, Eng.). Nuclear Energy, 464-7(1960) Oct.

Safeguards and monitoring procedures are considered for the contamination hazard which is more serious than the radiation hazard. The design of buildings and laboratories for minimum contamination is discussed, especially floors which should be concrete covered with waxed linoleum. Where only sealed radiation sources are used or a radiation hazard is present, periodic contamination checks of the environment (at least annually) are usually sufficient, but where open sources are used or active material is processed, daily routine survey checks should be made. Smear checks should be made before probe surveys in order to ensure that no removable contamination remains, and a reliable technique for making smear checks is described. The limitations of the probe survey due to surface absorption of the activity are emphasized, and, in order to interpret probe surveys, it is necessary to calibrate the technique under simulated conditions; an example of such calibration in clothes monitoring is presented. Air sampling is also treated; in the case where the isotope is dangerous even in small dosages a portable air sampling unit is needed in addition to routine continuous air monitors. The questionable practice of decreasing the sensitivity and counting period of hand monitors is discussed. It is emphasized that the variable conditions of contamination necessitate strict radiation hygiene. (D.L.C.)

2950 RADIATION DOSE AND RADIATION PROTECTION OF THE HUMAN LENS IN THERAPY NEAR THE EYE. Hans-Lother Kölling and Ernst Reuter (Universität, Jena, Ger.). Strahlentherapie 113, 299-311(1960) Oct. (In German)

Experimental studies are reported investigating the possible danger to the lens in radiotherapy of hemangiomas near the eye with and without protective shells. For orientation, roentgenograms and free-air measurements were made, and results obtained on paraffin phantoms with and without protective shells were reported. A significant protection of the lens against x and γ rays of the radium can be obtained only if the protective shells consist of lead or of lead glass containing a high percentage of lead, and have a thickness of 2 mm and a suitable shape. The protection given by the best shells is a little less than one-third of the dose measured without a shell, if the moulage is directly over the eye. If the moulage is near the eye, the use of a protective shell has no significance. For interstitial radium application in the upper and lower lid the protective effect of a protective shell is up to one-half of the dose measured without protection. The use of a protective shell could decrease the radiation burden of the lens considerably, but still it is high. The use of a contact protective lens over a longer period of time is dangerous for the cornea. Contact irradiation with a suitable effective protective shell is comparatively and absolutely the least dangerous method of treatment of hemangiomas near the eye. (auth)

2951 THE DANGER OF INCREASING THE CONCENTRATION OF C^{14} IN THE ATMOSPHERE. A. M. Kuzin Vestnik Akad. Nauk S.S.S.R. 30, No. 9, 48-51(1960) Sept. (In Russian)

As a result of nuclear testing the increase of C^{14} in the atmosphere was 8% in 1957 and 31% in 1959. The C^{14} dose is 1.5 mr/year out of a total dose of 150 mr/year. However, of all the natural sources of radiation (K^{40}, U, Th, Ra, cosmic rays, etc.) C^{14} occupies a special position, since it is directly incorporated into the structure of desoxyribonucleic acid which plays a leading role in the transmission of genetic characteristics. The frequency of genetic aberrations noted on treatment of Allium sera and Vicia fabla with C^{14} showed that radioactive carbon was 10 to 20 times more effective in causing genetic damage than an equivalent amount of external radiation. If nuclear testing is resumed and the rate of rise of C^{14} is the same as was observed for 1958, the C^{14} content will be 7 to 8 times larger in 30 years (one generation). The C^{14} dose will be 12 mr/year, equivalent to 120 to 240 mr/hr of external radiation. Thus the effective natural background will be doubled. It is possible that in one generation (30 years) about 12 million people will suffer severe genetic aberrations as a result. Hence, the problem of C^{14} in the atmosphere is of great practical importance, and more work should be performed on the biological effectiveness of C^{14} in causing genetic damage to the body. 12 references. (TTT)

2952 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, SEPTEMBER 1960. Volume 1, No. 6. Public Health Service, Washington, D. C. 62p. $0.50(OTS).

Data are presented on fall-out monitoring of milk, air, water, and food in the U. S. for early 1960. (T.R.H.)

2953 RADIOLOGICAL HEALTH DATA QUARTERLY REPORT, OCTOBER 1960. Volume 1, No. 7. Public Health Service, Washington, D. C. 72p. $1.00(OTS).

Data are given on fall-out in milk, air, and water and fall-out uptake by people in the U. S. (T.R.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

2954 (AD-239223) TO DETERMINE THE EFFECT OF IRRADIATION UPON THE WHOLESOMENESS OF

FOOD. Progress Report No. 9 [for] September 1959–March 1960. Elwood F. Reber, Om P. Malhotra, P. D. Beamer, and H. W. Norton. [Illinois. Univ., Urbana]. 15p. Contract DA-49-007-MD 72800.

Feeding irradiated beef to dogs had no significant effect on their growth, feed conversion, fertility, or lactation as compared to dogs fed nonirradiated beef. Feeding irradiated beef had no effect on the level of hemoglobin, red blood cell, white blood cell, or differential white blood cell counts. Feeding irradiated (5.58 megarads) beef depressed food consumption. There were fewer pups born to the dogs fed the 5.58 megarad irradiated beef, but there were only two bitches per treatment. It is concluded that the significant depression of food consumption and the questionable depression of the size of litters born to dogs fed irradiated beef as observed in this project should be investigated further. Male rats fed irradiated beef were protected to a greater extent by the subcutaneous administration of vitamin K than by the oral administration of this vitamin. The administration of testosterone to intact rats feed irradiated beef increased the incidence of the hemorrhagic syndrome. (auth)

2955 (AD-239240) MOUSE CARCINOGENICITY STUDY. Progress Report [for] period March 1, 1957–March 15, 1960. William B. Deichmann. Miami. Univ., Coral Gables, Fla. School of Medicine. 12p. Contract DA-49-007-MD-789.

Swiss, C3H, C57 black, and DBA mice were fed a mixture of irradiated tuna, sweet potatoes, fruit compote, beef, and corn for the duration of their lives. Gross pathological examination for tumors was performed. Tumor incidence in the four strains was the same for controls and experimental groups. (T.R.H.)

2956 (NP-9426) MEASUREMENT OF THE WEAR RATE OF CAST GRINDING BALLS USING RADIOACTIVE TRACERS. J. D. Keys and G. G. Eichholz. Canada. Dept. of Mines and Technical Surveys. Mines Branch. June 1960. 18p.

Available as Can. Dept. Mines and Tech. Surveys, Mines Branch, Tech. Bull. TB 18. $0.25.

The wear rate of grinding balls is usually difficult to determine under operational conditions, and little is known about the factors determining ball life. Radioactive tracers have been used successfully to mark cast steel balls to obtain information on their life under various operating conditions in comparison with balls of different type or composition. A batch of marked steel balls was observed in a mill operation over a period of several weeks, and statistics on wear and loss of weight were obtained. In earlier test runs in which Fe^{59} was used, techniques were established, and qualitative observations were made on wear rate. In the present experiments, Co^{60}, which was added to the molten metal prior to casting, was used as the tracer. The cast balls were used in a mill at an iron mine. The radioactive batch was added to the ball mill, which had a normal charge of about 77.3 tons (metric). The charge was sampled at weekly intervals to pick out some of the radioactive balls. These balls were inspected and weighed, and the wear rate was calculated. This procedure proved to be a practical way of investigating grinding behavior under plant operating conditions. (auth)

2957 (NYO-2859) POTENTIAL APPLICATIONS OF RADIOISOTOPES TO THE MINING, PREPARATION, TRANSPORTATION, STORAGE, HANDLING, AND USE OF COAL. Harold J. Rose. Bituminous Coal Research, Inc., Pittsburgh. Nov. 1, 1960. 241p. Contract AT(30-1)-2311. OTS.

One hundred and ten numbered suggestions are presented for uses of radioisotopes in the production, transportation, and use of coal. Some of these applications are now in successful use by coal producers and coal users in the United States and have shown advantages over previous methods. About 80 of the ideas are reported to be in regular or experimental use somewhere in the world, for coal industry or analogous uses. Nuclear Equipment Ready for Regular Operating Use. For about 37 uses, it is believed that present nuclear equipment is suitable for regular use, with adaptations in specific cases. These include sealed and shielded radiation sources plus detectors, used as density gages, level indicators, etc., for automatic measurement and control. They can be used on the outside of pipes, bins, etc., without contacting materials being measured. Such nuclear devices can be made rugged, reliable, and low in maintenance compared with many nonnuclear devices for similar uses. They can be used safely by regular plant personnel after instruction. Nuclear Instruments and Techniques Available for Special Studies. For about 40 additional suggested uses, present nuclear instruments, techniques and "know-how" are available for studies to improve operations, processes, and maintenance in the industry. Nuclear-trained personnel (employees or consultants) would use existing instruments and techniques, plus ingenuity in planning tests for specific conditions. In some cases small amounts of unsealed radioisotopes would be used as tracers under safe conditions. Further research could increase the scope and value of radioisotopes for special studies. Uses for Which More Research and Development Are Needed. Of the remaining suggested uses, about 25 appear to be technically feasible but would require considerable research and development work before they would be ready for regular operating use. These include some of the potentially most important uses, and should receive prompt consideration. Basic and development research could best be sponsored by government agencies, while the design-engineering and product-development phases could be handled by equipment manufacturers or consultants in cooperation with large users. Suggestions Requiring Study as to Feasibility. Eight of the suggestions in this report refer to important needs of the coal industry for which radioisotopes have been suggested in general terms only. Further consideration is needed as to the technical feasibility of using radioisotope techniques. Promising ideas should receive basic and development research. Safety. All 110 suggested uses for radioisotopes can be handled safely and without justified cause for adverse employee or public reaction. The coal-mining industry is already very active and well-organized in matters of safety education and inspection, at company, state, and national levels. Some of the suggested uses could improve safety and health conditions. Market Data. Information is given on trends in coal production and use, on dollar value of equipment and supplies purchased, and on nonnuclear devices which may be competitive. This gives a basis for market studies of opportunities for radioisotope equipment in the coal industry. References. The 366 numbered references at the end of the report, cover about 500 items. They were selected from some 2500 items, originating in 15 coal-producing countries, which were considered for this report. (auth)

2958 (JPRS-2798) THE PROBLEM OF THE HARMLESSNESS OF USING FOOD PRODUCTS STERILIZED BY MEANS OF IONIZING RADIATION. G. M. Yegiazarov. Translated from Voprosy Pitaniya 19, No. 1, 63-6(1960). 7p. OTS.

Data are summarized on the safety of food products that

have been exposed to high levels of ionizing radiation. The possibility of the formation of new chemical combinations that possess toxic properties is considered. It is concluded that a considerably larger amount of experimental work must be done before a final opinion is formed. (C.H.)

2959 (JPRS-2832) THE PROBLEM OF HYGIENIC EVALUATION OF THE QUALITY OF MEAT IRRADIATED WITH IONIZING RADIATIONS. I. M. Buznik. Translated from Voprosy Pitaniya 19, No. 2, 63-9(1960). 11p. OTS.

Irradiation of fresh meat with γ rays leads to a slight change in its color and the development of an unpleasant extraneous odor. Upon irradiation under vacuum conditions and in a frozen state, the changes in organoleptic qualities are only slightly noticeable. Cooking of irradiated meat does not always completely remove the unpleasant odor. Changes in the organoleptic qualities are insignificant upon the irradiation of cooked meat. Irradiation of meat leads to a slight increase in aminoammonium-nitrogen. Divided determination of amino-nitrogen and ammonium showed an increase of both indicators. Inoculation of the wash-off of meat irradiated with an integral dose of 1.5 to 2 million r did not produce a growth of microorganisms. A growth of cocci was observed in meat irradiated with a 200,000- to 500,000-r dose. The number of microorganisms equalled tens and hundreds per gram of the product, while in nonirradiated meat the number of microorganisms equalled many tens and hundreds of thousands. Upon addition of a suspension of pure B. anthracoides culture to the meat, the growth of microorganisms was also observed in samples irradiated with a 1.5- to 2-million-r dose. (auth)

2960 (NP-tr-494) ON THE EFFECT OF DILUENT SOLUTIONS ON THE RESULT OF BACTERIAL COUNTS IN IRRADIATED AND FROZEN FISH. W. Schmidt-Lorenz. Translated by A. Schoenfeld (U.K.A.E.A. Atomic Energy Research Establishment) from Arch. Lebensmittelhyg. 11, No. 3, 60-4(1960). 14p. JCL.

An investigation is reported which sought to find a diluent for bacterial counts in irradiated fish, which does not kill bacteria during dilution. The diluents studied were distilled water, normal saline (0.85% NaCl), phosphate buffer, 0.1 per cent peptone, synthetic sea water, 0.1 per cent peptone + phosphate buffer, and 0.1 per cent peptone + normal saline. The 0.1 per cent peptone + normal saline solution is recommended as a suitable diluent. (T.R.H.)

2961 SELECTED BIBLIOGRAPHY [ON FOOD IRRADIATION]. Food Irradiation 1, 19-38(1960) July-Sept.

One hundred and forty references covering the years 1957 to 1959, with a few earlier works, are included. The references are grouped into four categories: food irradiation technology, packaging irradiated foods, wholesomeness and acceptance of irradiated foods, and radiation sources and dosimetry. (M.C.G.)

2962 RADIATION PRESERVATION OF MILK AND MILK PRODUCTS. VII. STORAGE STUDIES ON MILK SUBJECTED TO COBALT-60 RADIATION DISTILLATION. J. E. Hoff, J. H. Wertheim, R. N. Roychoudhury, S. T. Deolalkar, B. E. Proctor, and S. A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Food Technol. 12, 648-54(1958).

It was found that radiation-sterilized milk possessed poor storage stability. The changes that occurred were especially pronounced in storage at and above room temperature. After storage at 30°C for a few days, the irradiated milk started to become brown, and the intensity of the brown color progressed with time. An increase in viscosity was observed and finally gel formation occurred. Upon continued storage, the gel separated into curd and whey. Changes in processing conditions did not result in irradiated milk of adequate storage life at or above room temperature. Small amounts of sulfur dioxide and sulfydryl compounds added before irradiation were found to reduce the development of browning and to reduce the tendency toward gelation. (M.C.G.)

2963 STORAGE CHARACTERISTICS OF SOME IRRADIATED FOODS HELD AT VARIOUS TEMPERATURES ABOVE FREEZING. I. STUDIES WITH CHICKEN MEAT AND SWEET POTATOES. J. J. Licciardello, J. T. R. Nickerson, B. E. Proctor, and C. L. Campbell (Massachusetts Inst. of Tech., Cambridge). Food Technol. 13, 398-404(1959) July.

Storage studies were carried out with irradiated chicken and sweet potatoes held at temperatures ranging from 50 to 125°F for 8 to 10 months. Products stored at 50 and 68°F were still regarded as acceptable after eight to 10 months. Deterioration in quality occurred within one month when samples were stored at 125°F. With irradiated chicken, shelf life was limited by: proteolytic enzyme action which resulted in poor texture; non-enzymatic browning, which caused undesirable color changes and presumably imparted a bitter off-flavor; and by the development of oxidative rancidity, particularly at the lower storage temperatures. Internal corrosion of the metal container occurred during the storage of irradiated sweet potatoes. This produced a metallic flavor in the product and was the chief cause of loss of quality. Vitamin analysis for thiamin, riboflavin and pyridoxine indicated that the amount of these vitamins destroyed by a sterilizing dose of cathode rays was comparable to the amount destroyed by conventional methods of thermal processing. Loss of vitamins in irradiated samples or heat-processed samples during storage at similar temperatures proceeded at about the same rate during storage. (auth)

2964 STORAGE CHARACTERISTICS OF SOME IRRADIATED FOODS HELD AT VARIOUS TEMPERATURES ABOVE FREEZING. II. STUDIES WITH PORK SAUSAGE AND SCALLOPS. J. J. Licciardello, J. T. R. Nickerson, B. E. Proctor, and C. L. Campbell (Massachusetts Inst. of Tech., Cambridge). Food Technol. 13, 405-9(1959) July.

Storage studies were carried out with irradiated pork sausage and scallops held for 8 to 10 months at temperatures ranging from 50 to 125°F. Even after 8 months' storage at 50°F irradiated pork sausage was considered acceptable in flavor. At storage temperatures of 68°F or above, irradiated samples became unacceptable within 2 months. Irradiated scallops were considered to be acceptable after 10 months' storage at 50 to 68°F; however, a marked deterioration in quality occurred within 1 month in samples held at 125°F. Nonenzymatic browning, which caused off-flavor and color degradation, played the principal role in the deterioration of irradiated scallops during storage, but texture losses also occurred. In the case of irradiated pork sausage, texture change and associated off-flavors due to proteolytic enzyme action chiefly contributed to loss of quality. Color changes and fat oxidation also occurred. (auth)

2965 RADIATION PRESERVATION OF MILK. X. STUDIES ON THE RADIATION INDUCED GELATION OF CONCENTRATED MILK. METHODS, AND EFFECT OF SOME ADDITIVES. J. E. Hoff, J. Sunyach, B. E. Proctor, and S. A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Food Technol. 14, 24-6(1960) Jan.

A method was devised by which radioinduced gelation of

concentrated milk could be studied. The addition of 20 milliequivalents of Mn^{2+} per liter of concentrated milk (3:1) totally prevented gelation within the experimental period (60 days). The formation of a gel during storage at 37°C was considerably delayed by the addition of the divalent cations, Mg^{2+} and Mn^{2+}, whereas Ca^{2+} had no effect. Phosphate and citrate were found to enhance gelation. When the gelation of the irradiated milk was induced by heating at 90°C, Ca^{2+} addition effected an increase in gel strength, whereas citrate and phosphate reduced the gel strength. No significant change in gelling time was observed under these conditions. On the basis of the experimental observations it is suggested that irradiation causes the rupture of pyrophosphate linkages essential to the stability of the casein micelles. (auth)

2966 RADIATION PRESERVATION OF MILK. XI. STUDIES ON THE RADIATION-INDUCED GELATION OF CONCENTRATED MILK. THE EFFECT OF POLYPHOSPHATES. J. E. Hoff, J. Sunyach, B. E. Proctor, and S. A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Food Technol. 14, 27-9(1960) Jan.

The addition of polyphosphates to concentrated (3:1) milk before irradiation markedly reduced the tendency of irradiated milk to develop a gel when stored at 37°C. ATP, tripolyphosphate and "hexametaphosphate" were able to prevent gel formation for an undetermined length of time in excess of 2 months at 37°C when added in amounts above a certain threshold value specific for each compound. Pyrophosphate did not exhibit this phenomenon. The analysis of ultrafiltrates of irradiated milk demonstrated that the irradiation caused a release of Ca^{2+}, Mg^{2+}, and phosphate ions from complexing with the casein. Addition of tripolyphosphate to irradiated milk caused an increased complexing of these ions with casein. Nearly all the added tripolyphosphate was found to complex with the protein. Irradiation of milk with added tripolyphosphate did not affect the metal-protein complex, but did result in a release of inorganic orthophosphate and other phosphates from the casein complex. The experimental results are discussed and an interpretation of the effects of irradiation and of the addition of metal ions and polyphosphate is attempted. (auth)

2967 RADIATION PRESERVATION OF MILK AND MILK PRODUCTS. V. PRECURSORS TO THE RADIATION-INDUCED OXIDATION FLAVOR OF MILK FAT. J. E. Hoff, J. H. Wertheim, and B. E. Proctor (Massachusetts Inst. of Tech., Cambridge). J. Dairy Sci. 42, 468-75(1959) Mar.

Oxidation flavor produced upon irradiation of milk fat is derived from certain of its component fatty acids. One of these acids was identified as linolenic acid. Other acids required for production of irradiation-induced oxidation flavor were isolated in an unidentified mixture. This unknown isolate is believed to contain the vinyl group and branched chains. Linolenic acid produced a fishy flavor upon irradiation, while the mixture of fatty acids containing the vinyl group and branched chains gave rise to a flavor characterized as candle-like. These two flavors blended upon mixing to give the typical tallowy oxidation flavor of irradiated milk fat. (auth)

2968 APPLICATION POSSIBILITIES OF TRITIUM BREMSSTRAHLUNG IN INDUSTRY. W. Kühn and F. Herrmann (Institut Karlsruhe der Isotopen-Studiengesellschaft e. V., Ger.). Kerntechnik 2, 268-70(1960) Sept. (In German)

The determination of solution concentration or weight fraction of heavy atoms in multicomponent systems by use of low-energy γ or x radiation is possible with a high sensitivity as a result of the great variation of the mass absorption coefficient with density. The measurement methods and apparatus used for determination of solution concentrations are described, and the results obtained are shown graphically. (J.S.R.)

2969 RADIOISOTOPE STUDY OF THE PROPERTIES OF AND THE PROCESSES IN PEAT. M. P. Volarovich. Kolloid. Zhur. 22, 524-34(1960) Sept.-Oct. (In Russian)

A brief description is given of the results of the work of the Radioisotope Laboratory of the Kalinin Peat Institute. A laboratory study was made of the aqueous properties and structure of peat. An investigation was made of heat and moisture transport in peat under laboratory conditions. Field studies of the movement of water in peat deposits were carried out. The mixing of peat during its mechanical treatment in peat-processing machines was investigated. The application of nuclear radiation in determinations of the weight by volume and moisture content of peat was studied. In order to solve these problems a number of special methods employing various radioisotopes were devised. The results find application in the colloid chemistry and physics of peat, as well as in the hydrodynamics and technology of this material and in peat mechanics. (auth)

2970 DETERMINING CYLINDER WEAR. W. C. Arnold, and V. T. Stonehocker (Fairbanks, Morse & Co., [Beloit, Wis.]). Nuclear Energy, 492-3(1960) Oct.

A tracer technique was developed for measuring the wear of cylinder liners in engines. In the technique development a 42-in.-long 160-lb cylinder liner, designed for a $8\frac{1}{8} \times 10$-in. opposed piston diesel engine, was irradiated in a pool reactor at the inner-dead-center-ring travel where maximum wear occurs. The 300-day Mn^{54} was formed by neutron activation of Fe^{54} together with small amounts of Fe^{59} and Cr^{51}. Handling and health-physics procedures involved in the transportation of the irradiated liner and installation in the engine are described. Radioassay techniques were developed for analyzing wear products in both the lubricating oil and exhaust gas, using an immersion scintillation crystal detector coupled with a precision scaler for the lube oil and a scintillation well counter for the gas. The precision of the tracer technique was determined by comparing tracer-measured wear with micrometer-measured actual wear. (D.L.C.)

2971 VULCANIZATION OF RUBBER BY γ RAYS. G. Lamm (Laboratoire de Recherches et de contrôle du Caoutchoc, [Paris]), A. Lamm, and H. Madelaine. Rev. gén caoutchouc 36, 1163-77(1959). (In French). (CEA-1375)

A review of earlier work on the vulcanization of rubber by radiations is followed by a study of the influence of numerous additives and of the irradiation medium on the speed of vulcanization by γ radiation. A chlorinated monomer (dichlorostyrene), a nonmonomeric halogen derivative (Freon-113), a metal oxide (litharge), and the combination litharge-p-dichlorobenzene had the most stimulating effects on the action of radiation. A comparison between radiovulcanizers and chemical vulcanizers has shown that one method of vulcanization cannot be considered superior to the other on an over-all basis. The classification depends on the criterion chosen. (auth)

2972 RADIATION FLAVOR—FACT OR FANCY. Maurice P. Drake, Beverley J. Kroll, and Francis J. Pilgrim (Quartermaster Food and Container Inst., Chicago). Science 132, 1394-5(1960) Nov. 11.

Experimental results indicate that sensory evaluations in different laboratories give equivalent results if standardized procedures and a standard sample are used. Conflicting results concerning the flavor of irradiated foods are due largely to different methods of evaluation and to incorrect interpretation of results. Unusual flavor due to irradiation should be considered different, not necessarily objectionable. (auth)

2973 A RAPID METHOD FOR DETERMINING THE ASH CONTENT OF COAL BY β-RAY SCATTERING. N. V. Gorbatyuk, G. Z. Borukhovich, V. V. Parkhomenko, and A. V. Chashinov ("Red Metal Worker" Plant, [USSR]). Zavodskaya Lab. 26, 1094-6(1960). (In Russian)

In an attempt to eliminate the laborious methods used for determining the ash content of coal in dressing plants, methods involving the use of radioisotopes were studied. Results obtained with a method based on the attenuation of the emitted x radiation or bremsstrahlung of Tl^{204} with the help of a scintillation counter showed the strong influence of extraneous factors such as moisture content, chemical composition of the ash, and the degree of collimation of the beam. On the other hand, determination of the back scattering of β radiation, which was primarily dependent on the heavy elements in the sample, yielded good results, showing smaller errors than obtained with γ rays. A 50-millicurie Sr^{90} source was used, which had been calibrated with standard samples prepared from a coal with 7.8% and a mineral with 74.4% ash content. Measurements made with this source and with Tl^{204} showed a direct correlation between the intensity of back scattering and the ash content. Under industrial field conditions the Sr^{90} yielded an average error of 0.1% and the Tl^{204} source an error of 1%. Density changes did not affect the result, but an increase of the heavy element content resulted in higher readings. Individual measurements were completed in 1 min. (TTT)

ISOTOPE SEPARATION

2974 (CEA-1458) PRODUCTION DE RADIOÉLÉMENTS ARTIFICIELS. (Production of Artificial Radioelements). C. Fisher. France. Commissariat à l' Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 10p.

The techniques used in the production of artificial radioelements are described, with special emphasis on nuclear reactions and use of reactors, chemical-separation methods, methods for enriching the activity preparations, protection of personnel, and handling methods. (auth)

2975 (TID-6754) SEPARATION OF ISOTOPES. Annual Progress Report. T. I. Taylor. Columbia Univ., New York. Sept. 1, 1960. 80p. Contract AT(30-1)-755. (CU-13-60-AT(30-1)-755-Chem.). OTS.

The exchange of NO with N_2O_3 in the preparation of 99.7% N^{15} is reported. Short columns were operated in cascade at about −10 to −12°C. This exchange system is compared with the exchange of NO with HNO_3 used previously for preparation of 99.9% N^{15}. The exchange of NO with an alcoholic solution of an addition complex between NO and $CuCl_2$ was investigated for its use in the concentration of N^{15} and O^{18} by an exchange-distillation method. A number of relevant properties of the system, including the single-stage enrichment factors, were determined. Research to determine the optimum operating conditions of a two-meter exchange column packed with glass helices is described. Previously reported data indicate that the exchange of CO_2 with water can be used for the concentration of O^{18}; however, the exchange is slow and effective catalysts for the exchange are necessary. Experiments with ethanolamines showed that these compounds did not sufficiently catalyze the reaction for practical use. A reflux system was developed for the CO_2-H_2O exchange. Other catalysts will be tried using this system. (For preceding report see NP-6574.) (J.R.D.)

2976 (AEC-tr-4297) SEPARATION AND CONCENTRATION COURSE OF THE OXYGEN ISOTOPES O^{16}, O^{17}, AND O^{18} IN THE DISTILLATION OF WATER IN A PRECISION DISTILLATION APPARATUS. M. Thürkauf, A. Narten, and Werner Kuhn. Translated for (Oak Ridge National Lab.) from Helv. Chim. Acta 43, 889-1004(1960). 49p. (Includes original, 16p.). JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 21581.

2977 (CEA-tr-A-700) PROCÉDÉ POUR LA PRÉPARATION DE L'EAU LOURDE. (Process for Preparation of Heavy Water). Translated into French from German Patent 1050 319. Inventor: P. Harteck. [Patent granted] Feb. 12, 1959. 16p.

A simple and economical process for producing D_2O is offered. It is an improvement of the known process in which isotopic exchange takes place between H_2O and H_2S flowing countercurrently in hot and cold columns with the H_2S being recycled. The improvement lies in adding to the H_2S a substance which is miscible with it but practically immiscible with the water and which has a vapor pressure lower than that of H_2S. Some of the substances which can be used are ethylene chloride, carbon disulfide, ethyl chloride, butane, pentane, and methyl or ethyl mercaptan. (T.R.H.)

2978 (CEA-tr-A-727) PROCÉDÉ DE PRODUCTION DE DEUTÉRIUM. (Process for Production of Deuterium). E. A. Zdansky. Translated into French from Swiss Patent No. 340-492. [nd]. 4p.

A process is described for producing D_2 by fractional distillation of liquid hydrogen. The hydrogen is produced electrolytically under a pressure of at least 5 atm, liquefied, and put in a distillation apparatus. (T.R.H.)

2979 SEPARATION OF THE STABLE ISOTOPES OF BORON. N. N. Sevryugova, O. V. Uvarov, and N. M. Zhavoronkov. Atomnaya Energ. 9, 110-25(1960) Aug. (In Russian)

A survey is given of various methods for separating stable boron isotopes. Three of the described methods can be applied to B^{10} concentration on an industrial scale. Chemical exchange has a comparably larger coefficient of separation ($\alpha = 1.03$); however, the efficiency is low owing to the large molecular weights of the complexes used. Preparation of B^{10} by thermal diffusion with BF_3 rectification ($\alpha = 1.0075$) is anticipated; however, the process must be carried out at 100°C, requiring large quantities of liquid air. In BCl_3 exchange, α is small (1.003), but the process can be carried out under atmospheric conditions at room temperature. 71 references. (tr-auth)

2980 EXCHANGE AS A MEANS OF SEPARATING THE ISOTOPES OF BORON. B. P. Kiselev. Atomnaya Energ. 9, 312-13(1960) Oct. (In Russian)

An exchange reaction between gaseous BF_3 and BF_4^- is suggested. The exchange between hydrofluoboric acid (saturated hydrous solution 18.5 N) and gaseous BF_3 is expressed as: $B^{10}F_4^- + B^{11}F_3 \rightleftharpoons B^{11}F_4^- + B^{10}F_3$. In such a reaction, the lighter B^{10} concentrates in the gaseous phase. Data on one and two stage exchange are tabulated. Isotopic analysis carried out with a mass-spectrometer (ms-2m) indicates that the separation coefficient (1.028 ± 0.008) for

the reaction is higher, by order of one, than for the BF_3 distillation method. The experiments were made at 20 to 30°C. (R.V.J.)

2981 SELECTIVE EFFECT OF FLAMES IN THE LATERAL DIFFUSION OF MINERAL ELEMENTS INTRODUCED IN SOLUTION. APPLICATION TO ISOTOPIC ENRICHMENT. Marcel Servigne and Jean-Louis Siémons (Institut National Agronomique, [Paris]). Compt. rend. 251, 1217-19(1960) Sept. 19. (In French)

The pulverization of mineral salts in a flame, a technique long used in flame spectrophotometry, does not occur without a small loss of mineral elements by lateral diffusion. The precise chemical composition of these diffused minerals can be determined by deposition of the diffusants on cold walls near the flame. The composition was determined and the results showed that the majority of the metallic elements were deposited in a manner characteristic of each. The deposition processes have a selective character in that the diffusants are enriched in the lighter particles. The application of the method to isotope separation is suggested. (J.S.R.)

2982 TWO-TEMPERATURE REGIMES OF PRODUCING HEAVY WATER. K. I. Sakodynskiĭ and N. M. Zhavoronkov (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Uspekhi Khim. 29, 1112-37 (1960) Sept. (In Russian)

Electrolysis of water, electrolysis of water combined with isotopic exchange between water and hydrogen, fractionation of water, low-temperature fractionation of hydrogen, and exchange between water and H_2S at two different temperatures are the principal industrial methods of producing heavy water. Calculations show that 90% of the cost is involved in concentrating ordinary water to a content of 1 to 2% D_2O, and that the exchange reactions operating at two temperatures are the most economical. Since the exchange between water and H_2S at two different temperatures is the only method known at present which can produce heavy water at a low cost on a greatly expanded scale, considerable attention is devoted to the separation coefficients, apparatus arrangement and construction, corrosion problems, and economics of this method. It is also pointed out that the water-hydrogen exchange at 100 and 600°C can be used to produce limited amounts of heavy water economically where hydrogen is available cheaply as in the synthesis of ammonia. 132 references. (TTT)

2983 INVERSION OF THE SEPARATING NOZZLE DECOMPOSITION IN SUPER-EXPANDED GAS BEAMS. K. Bier (Technische Hochschule, Karlsruhe, Ger.). Z. Naturforsch. 15a, 714-23(1960) Aug. (In German)

The "normal" separating nozzle effect is based on the enrichment of the light component in the boundary zone of the beam in the flow of a gas or isotopic mixture from a nozzle during the first part of the free expansion. This effect occurs both in rotational-symmetrical and in plane nozzle flow. In rotational-symmetrical gas beams an inverse decomposition is observed at sufficiently high densities at greater distances from the nozzle; that is, an enrichment of the light component occurs in the beam center. In the present work, by investigation of the spatial behavior of the decomposition at various gas pressures, it was shown that the "reversed" separation effect depends essentially on the pressure diffusion in the pressure gradient from the outside to the inside synthesized by a compression. (tr-auth)

2984 SEPARATION COEFFICIENTS OF CHLORINE IN THE EQUILIBRIUM VAPORIZATION OF Cl_2. K. I. Matveev, O. V. Uvarov, and N. M. Zhavoronkov (Karpov Inst. of Physical Chemistry, [USSR]). Zhur. Fiz. Khim. 34, 2123(1960) Sept. (In Russian)

The temperature dependence of the separation coefficients of Cl^{35} and Cl^{37} at equilibrium molecular chlorine evaporation was measured using previously derived coefficients for separation at equilibrium HCl evaporation. Partial pressures of various isotopes were determined using a mass spectrometer. The tabulated data indicate separation coefficients of 1.0015 to 1.0010 by molecular chlorine rectification even at pressures of ~100 to 200 mm Hg. (R.V.J.)

MATHEMATICS AND COMPUTERS

2985 (R-351(RAND)) THE RAND SYMPOSIUM ON MATHEMATICAL PROGRAMMING. LINEAR PROGRAMMING AND RECENT EXTENSIONS. PROCEEDINGS OF A CONFERENCE, MARCH 16-20, 1959. Philip Wolfe, ed. RAND Corp., Santa Monica, Calif. 1960. 100p.

Summaries are given for the 57 papers presented at a meeting on linear programming and its recent applications. Areas of interest covered included formulation and applications, economic models and dynamic programming, general linear programming, special structures, discrete programming, network theory, nonlinear programming, and programming under uncertainty. (W.D.M.)

2986 (TID-6673(Pts.I and II)) LISTING OF ANP 704 COMPUTER PROGRAMS. M. Campbell. General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. July 17, 1959. (Pt. I, 228p., Pt. II, 191p.). OTS.

Parts I and II may be further identified as DC-59-7-179 and DC-59-7-180, respectively.

IBM-704 programs that either are being or have been developed for the ANP Department are listed. Abstracts, references, status, etc. are given for programs 1 through 370. (W.D.M.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

2987 (AD-238715) FEASIBILITY STUDY OF PLASMA WELDING OF REFRACTORY METALS. Progress Report No. 3 for the Periods November 1, 1959 to January 1, 1960 and January 1 to March 1, 1960. Jess W. Wilson. Stanford Research Inst., Menlo Park, Calif. Mar. 22, 1960. 4p. SRI Project No. SU-2927.

A previously described plasma torch was operated over a wide range of power inputs to establish optimum flame characteristics. The operating characteristics of the torch are presented. The torch efficiency increases in proportion to the gas flow, but the enthalpy of the stream measured as Btu/lb of argon decreases with increasing argon flow. Additional data from operation of nozzles with improved configuration are required before optimum compromise of parameters can be established. (J.R.D.)

2988 (BMI-1468) PROGRESS ON CERAMIC COATED FUEL PARTICLES AT BATTELLE. Battelle Memorial Inst., Columbus, Ohio. Sept. 16, 1960. 33p. Contract W-7405-eng-92. OTS.

Presented at the AEC Information Meeting held at Battelle Memorial Institute, July 12, 1960.

About 500,000 particles of fully enriched UO_2, each

coated with 40μ of Al_2O_3, were irradiated at 1500°F in the Battelle Research Reactor. After 70 days for a burn-up of 3% of the U^{235}, or 30,000 Mwd per ton of uranium, these particles continued to show excellent fission-gas retention. A review of the work on Al_2O_3-coated UO_2 particles and on carbon-coated UC_2 particles is presented. Many of the fuel applications currently of interest involve the use of coated fuel particles dispersed in a suitable matrix. Graphite is the logical matrix choice for carbon-coated UC_2, and Al_2O_3 or graphite is the choice for UO_2 particles coated with Al_2O_3. Some exploratory work on pressing oxide-coated UO_2 shows that the as-produced particles can be aggregated to form a pellet. Work on the fabrication and evaluation of bodies containing coated fuel particles is described. (W.L.H.)

2989 (BMI-1471) ALUMINA COATING OF UO_2 SHOT BY HYDROLYSIS OF ALUMINUM CHLORIDE VAPOR. Melvin F. Browning, Neil D. Veigel, Thomas E. Cook, Ward S. Diethorn, and John M. Blocher, Jr. Battelle Memorial Inst., Columbus, Ohio. Oct. 25, 1960. 15p. Contract W-7405-eng-92. OTS.

Uniform, dense coatings of alumina about 5 to 150 μ thick were applied to uranium dioxide particles 44 to 350 μ in diameter by hydrolysis of aluminum chloride vapor in a fluidized bed of the particles at 1830°F. The coated particles were resistant to nitric acid leaching, to oxidation in 1830°F air, and to thermal cycling from 600 to 2500°F. After low neutron exposures, the coated particles showed excellent fission-gas retention at temperatures up to 2400°F in inert gas. Although not optimized in the study, the coating process appears to have commercial feasibility. (auth)

2990 (CRDC-969) THE DETERMINATION OF FISSION-PRODUCT XENON RELEASED BY UO_2 IN FUEL ELEMENTS. W. W. Morgan, R. W. Jones, and W. J. Olmstead. Atomic Energy of Canada Ltd., Chalk River, Ont. Sept. 1960. 17p. (AECL-1100). AECL.

A method was developed for determining the amount of fission-product xenon released to the fuel-sheath interface of an irradiated fuel element. The Zircaloy-clad uranium dioxide element is punctured in an evacuated chamber inside a hot cell. All the gas in the accessible void volume is then pumped to a purification and measuring system where nitrogen and oxygen are removed on a calcium getter at 700°C. Xenon is separated from the other noble gases by freezing at −196°C. After purification, the xenon is expanded into a calibrated volume where the pressure is measured on a McLeod gage. The purity of the xenon is checked by mass-spectrometer analysis. The over-all accuracy of the method is ±2%. (auth)

2991 (KAPL-2000-11(p.IV.17-IV.20)) DECONTAMINATION OF STAINLESS STEELS BY THE APAC PROCESS. M. E. Jones. Knolls Atomic Power Lab., Schenectady, N. Y.

Tests were made to determine the effect of the APAC decontamination process on several materials. Flat coupon, ground, U-bend stress, and crevice specimens made up from types 304, 347, and 308 stainless steel were used in the test. The decontamination treatments removed the oxide film from the precorroded specimens with very slight attack of base metal. The metal losses of coupons during the decontamination corresponded to the following penetrations: type 304 stainless steel, annealed, 0.0014 mil; type 304 stainless steel, sensitized, 0.0047 mil; type 308 stainless steel, sensitized, 0.0048 mil; and type 304 stainless steel, sensitized, then ground, 0.0044 mil. (W.L.H.)

2992 (LA-1387(Del.)) REMOTE CONTROL EQUIPMENT FOR PLUTONIUM METAL PRODUCTION. Wayne C. Hazen. Los Alamos Scientific Lab., N. Mex. Oct. 1, 1951. Decl. with deletions June 9, 1960. 221p. OTS.

Design and construction of remote control equipment for plutonium metal production are described. Criteria for the design of the equipment included the following: rubber gloves were to be completely eliminated; all mechanisms were to be built as integral units to facilitate replacement through use of the plastic-bag technique; no accessory equipment such as switches, valves, piping, or cylinders were to be inside the contaminated enclosure unless required to handle the plutonium; and all units were to be tested in mockups before final design. The chemical process, general layout, and operating function are outlined. Descriptions are given of all mechanical units, electrical systems, hydroxide slurry systems, ventilation systems, and chemical tanks and manifolds. (W.L.H.)

2993 (NP-9407) DEVELOPMENT OF EXO-REACTANT INORGANIC ADHESIVE SYSTEM. Quarterly Progress Report No. 4 covering Period July 1–September 30, 1960. William Bassett and Roger A. Long. Narmco Industries Inc., San Diego, Calif. Oct. 1, 1960. 23p. Contract NOas 60-6061-c.

Research was devoted to completing the refinement of the copper- and silver-based exothermic adhesive systems for overlap bonding, fabricating overlap specimens specified in the contract, and continuing the development of an exothermic-adhesive composition and associated procedures for honeycomb-panel bonding. Stainless-steel lap-shear strengths using silver-base exotherms were consistently above 5300 psi with most failures in the stainless parent metal, the average strength being 9173 psi. No appreciable change in strength was noted up to 600°F. At 800°F this average was 8941 psi. Bend tests demonstrated that the bonds were metallic, with little or no included glass. Honeycomb-core-cell bonding to skins was achieved but core-cell burn-through, although greatly reduced, still remained a problem. (auth)

2994 (NP-9419) PHYSICAL METALLURGY AND USES OF GOLD. BIBLIOGRAPHY FOR THE TEN-YEAR PERIOD 1950–1959. L. Badone and N. S. Spence. Canada. Dept. of Mines and Technical Surveys. Mines Branch. Jan. 1960. 90p. Available as Can. Dept. Mines and Tech. Surveys, Mines Branch, Inform. Circ. IC-116. $0.25.

A survey was made of 884 references from report and journal literature published during the period 1950–1959. The references for each year are arranged alphabetically by first author. (W.L.H.)

2995 (ORNL-1429) SOLID STATE DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 10, 1952. J. T. Howe, ed. Oak Ridge National Lab., Tenn. Mar. 4, 1953. Decl. July 12, 1960. 57p. Contract W-7405-eng-26. OTS.

Previously reported large creep rates in Inconel were shown to be a result of erratic behavior of microformer transducers. Several coil-spring type transducers were fabricated and tested. Impact tests were made on irradiated carbon steel. A program of tests was initiated to determine radiation effects on bonded-wire resistance strain gages. Reactor fuels Nos. 21 and 27 ($NaF-KF-ZrF_4-UF_4$ and $NaF-ZrF_4-UF_4$, respectively) were irradiated in Inconel capsules. A dynamic-corrosion apparatus for the Materials Testing Reactor (MTR) was designed. Hardness measurements were plotted against penetration distance for aluminum bombarded with 100 a/hr of 21-Mev protons. A method is proposed for in-pile determinations of dielec-

tric constant and attenuation factor of insulators in cables. Design and fabrication of equipment for remote metallographic specimens were completed. Radiation effects on thermocouples are reported. Nuclear-heat generation in type 347 stainless steel was measured. Neutron spectra in the Bulk Shielding Facility were investigated. Fast-neutron bombardment of diamond, quartz, and cubic SiC produced a continuing lattice expansion. Thermally unstable radiation-produced disorder is retained by germanium at −78°C. Irradiation of germanium showed that there is a continuous decrease in resistivity and Hall coefficient with decrease in temperature. Data are reported on annealing of KCl F centers and radiation stability of plastics and elastomers. (L.T.W.)

2996 (ORNL-1851) SOLID STATE DIVISION SEMI-ANNUAL PROGRESS REPORT FOR PERIOD ENDING FEBRUARY 28, 1955. J. T. Howe, ed. Oak Ridge National Lab., Tenn. May 9, 1955. Decl. July 12, 1960. 36p. Contract W-7405-eng-26. OTS.

Radiation Metallurgy. In-pile testing of the stress-corrosion apparatus described in another report was conducted in the LITR. The reactor ran at full power for 700 hr, and a stress of 1000 psi caused no gross increase in creep rate. Engineering Properties. The LITR fused salt test loop was installed in the reactor and operated at 8 to 10 fps for 645 hr. Only ⅓ of the anticipated power generation was noted in the loop. Fused Salts. An in-pile dynamic-corrosion loop was designed for vertical operation in the LITR. Provision was made for the increase in reactivity which might be introduced by a rupture of the loop. Some analytical results on the effects of radiation on static corrosion by the UF_3- and UF_4- series fused salts are presented. A radioassay showed that the iron in these samples is mostly inert and is not a result of corrosion. Further improvements were made in the design of the MTR irradiation capsule. More uniform capsule temperatures were achieved, and an improved thermocouple was included. Equipment was designed for transferring fused salts and dynamic-corrosion loops to hot cells where they are to be analyzed. UF_6 dissolved in C_7F_{16} was found to be unsuitable for the study of short-lived fission products because of its inadequate resistance to radiation. (W.L.H.)

2997 (ORNL-2189) SOLID STATE DIVISION SEMI-ANNUAL PROGRESS REPORT FOR PERIOD ENDING AUGUST 30, 1956. Oak Ridge National Lab., Tenn. Dec. 13, 1956. Decl. July 12, 1960. 39p. Contract W-7405-eng-26. OTS.

MTR in-pile loop 3 was disassembled, and all components were examined metallographically. Chemical analyses of fuel and other materials from loop 3 were made. Irradiation of static corrosion capsules in the MTR was continued. The modified motor and pump for use in the LITR vertical in-pile loop are shown. Performance curves with H_2O are given for this pump. Data are included on the estimated Reynolds number of the fuel mixture in the loop. An improved method of analog computation is presented for the vertical miniature in-pile loop. Calculated temperature and heat-transfer-function profiles for the LITR in-pile loop are included. Electronic analog simulation was used to investigate the possibility that fluctuations in the efficiency of removal of xenon from the fuel by the pumps might be caused. The use of Zr^{95} as a fission monitor is briefly discussed. Research in hot metallography and hot-cell operation is briefly reviewed. Creep and stress-corrosion tests were made on Inconel tubing. Static irradiations were completed on high-temperature ceramic fuel plates. A method was developed for making autoradiograph pictures of the irradiated fuel plates using a lead pin-hole camera. Results are reported of an irradiation survey of several boron carbide bodies for high-temperature shields. (For preceding period see ORNL-2052.) (W.L.H.)

2998 (RADC-TN-59-370) METAL-TO-CERAMIC SEAL TECHNOLOGY STUDY. First Technical Note Covering the Period June 30, 1959 to September 30, 1959. S. Cole, Jr., H. Larisch, and E. Cheatham. Sperry Gyroscope Co. Electronic Tube Div., Great Neck, N. Y. Oct. 1959. 89p. Project No. 4506. Contract AF30(602)-2047. (NA-8240-8184-1; AD-234669).

After a preliminary literature study, an intensive metalizing investigation was planned and is now in progress. Initially, four ceramic bodies of varying Al_2O_3 content were selected and are now being used in this program. Over 200 metalizing compositions were formulated after consideration of thermodynamic principles and chemical and physical adherence mechanisms. A testing investigation was planned, two phases of which are in progress (peel testing and compression testing). These programs are designed to render data which is to be correlated with standard ASTM tensile tests. New tensile-test specimen designs were accomplished. A stress investigation was planned and is in progress. Theoretical considerations for both thin and thick wall seals were postulated. A test seal specimen was fabricated and is under investigation for experimental data. (auth)

2999 (TID-6809) THE PEBBLE BED REACTOR PROGRAM. Current Fuel Element Developments and Their Effects on the Pebble Bed Reactor Development Program. Sanderson and Porter, New York. May 10, 1960. Decl. Sept. 23, 1960. 37p. Contracts AT(30-1)-2207 and AT(30-1)-2378. (S & P-1965-17). OTS.

Recent fuel element irradiations demonstrated the structural integrity of spherical uranium-graphite fuel elements at burn-ups in excess of the design requirements of a 125 Mw(e) Pebble Bed Reactor (PBR) power plant. Other irradiations indicated the successful development of a coated fuel particle which permits fabrication of fuel elements meeting the PBR design objectives of a fission-product release rate (R/B) ≤ 10^{-4}. β plus γ system activity in a 125 Mw(e) PBR is 490 c, assuming complete release of 10^{-4} of all fission products volatile at or below 2500°F. The low R/B being obtained from PBR fuel elements indicates that decay during diffusion of the short-lived volatile precursors of nonvolatile daughter products will result in further reduction of this system activity, and an increase in the average half life of the fission products remaining in the system will increase the efficiency of a bypass clean-up system. The method of fabricating coated particles by the hydrolysis of metallic chlorides to produce oxides or pyrolysis of hydrocarbons to produce carbon on a suitable substrate, is described, and preirradiation test results are given. An accelerated coated-fuel-particle program is discussed as well as development work on the Pebble Bed Reactor concept as a whole. (auth)

3000 (TID-6810) FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE PEBBLE BED REACTOR. Progress Report for July 1960. Sanderson and Porter, New York. Decl. Sept. 23, 1960. 18p. Contract AT(30-1)-2378. (S & P)-1964-23). OTS.

Gas flow was resumed through the sweep compartment of Capsule SP-5 which contains the graphite sphere fueled with Al_2O_3-coated UO_2. Leakage factors for Kr^{85m}, Kr^{87}, Kr^{88}, and Xe^{138} continued to remain in the range of 10^{-6} to

10^{-7} after a burn-up of 3.4 at. % U^{235} at a temperature of about 1350°F. However, the Xe^{133} release from this specimen rose to 10^{-4}. The cause for this increase in only one isotope is not yet evident. Analysis of the nonvolatile daughter trap for the FA-23 specimen, which is believed to have a crack in its Si–SiC surface coating, showed a dependency of leakage factor on half life of the volatile precursor. For example, the leakage factors were 4.6×10^{-6} for 1.7-sec Xe^{141} and 4.0×10^{-4} for 3.9-min Xe^{137}. This indicated that some portion of the fuel element (the graphite matrix, the unfueled graphite shell, or the damaged coating) is still offering sufficient diffusion resistance to reduce the leakage rate of short-lived isotopes by decay during diffusion. Evaluation of Al_2O_3-coated ThO_2/UO_2 and Al_2O_3-coated UO_2 having a porous inner layer of Al_2O_3 showed these batches to be promising. An α assay of a broken graphite sphere fueled with sintered Al_2O_3-coated UO_2 showed no damage to the particle coatings. Evaluation of several graphite spheres fueled with pyrolytic-carbon-coated UC_2 showed that the particle coatings has become damaged during the ball fabrication process. Natural-graphite pellets containing 5 pph binder were found to have good compressive strength and a density of 2.06 gm/cc. Spheres of this material will be made. (auth)

3001 (TID-6845) FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE PEBBLE BED REACTOR. Progress Report for June 1960. Sanderson and Porter, New York. Decl. Sept. 23, 1960. 15p. Contract AT(30-1)-2378. (S & P-1964-22). OTS.

Radiochemical analysis of a special nonvolatile daughter fission-product trap located close to the FA-22 specimen revealed leakage rates of short-lived isotopes, such as 3.2m Kr^{89}, 16s Xe^{140}, and 1.7s Xe^{141}, of the order of 10^{-7} which is the same order of magnitude as previously reported for the longer-lived Xe and Kr. This suggests that the observed leakage is predominantly due to uranium contamination external to the particle coatings. Additional batches of coated particles were prepared and preliminary evaluation showed promise. These batches included Al_2O_3 on ThO_2/UO_2 particles, a thick Al_2O_3 coating on UO_2 where an inner portion of the coating consists of porous Al_2O_3 which can store fission gases and minimize possible thermal-cycle rupture problems, and a thick pyrolytic-carbon coating on UC_2. Certain pellets of natural graphite and a resin binder were found to have rather good crushing strength while achieving graphite densities in excess of 2.0 g/cm^3. Assembly of components for the in-pile loop continued. (auth)

3002 (TID-6846) FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE PEBBLE BED REACTOR. Progress Report for May 1960. Sanderson and Porter, New York. 15p. Decl. Sept. 22, 1960. Contract AT(30-1)-2378. (S & P-1964-20). OTS.

A list of fuel-element types and their status in the test program is given along with the irradiation schedules for the various types of capsules and the in-pile loop. A graphite sphere fueled with vapor-deposited Al_2O_3-coated UO_2 particles continued to show excellent fission-product-retention characteristics under irradiation at about 1.5 kw nuclear heat generation per sphere and 1300°F surface temperature. The ratio of the rate of release to the rate of production of Xe^{133}, Xe^{135}, Kr^{85m}, and Kr^{88} ranged from 10^{-9} to 10^{-7}. Some degree of correlation was noted between specimen temperature and leakage rate. However, preliminary analysis of the first nonvolatiles trap for this specimen indicated that leakage rates of certain shorter lived volatile fission products have leakage factors about the same as the long-lived volatile fission products. This suggests that all leakage being observed may actually be due to a factor such as uranium contamination external to the Al_2O_3 coating. A sharp increase in leakage factor for the Si–SiC surface coated specimen, from 10^{-9} up to about 10^{-4}, indicated some sort of failure in this coating. Analysis of results on a 1000-hr heating test at 2500°F of Al_2O_3-coated UO_2 in graphite showed that lowest attack rates occurred with the thickest Al_2O_3 coating in the graphite matrix with the highest bake temperature. Although there was some evidence of reaction with furnace impurities, it appears that the limiting long-time temperature for this material should be below 2500°F. The first batch of UC_2 particles were coated with pyrolytic carbon at 1400°C deposition temperature. Sooting problems were eliminated by this higher temperature, but the massive coating consisted of many separate layers. The work on thorium nitrate infiltration was completed. A study of the use of natural graphite was continued by the preparation of a large number of pellets in which type of graphite, type of binder, and their proportions were varied. Mechanical characterization of several surface-coated spheres was completed. Hot-cell examination of the cracks which developed in the PyroC and Si–SiC coatings of Capsule SP-4 specimens was completed. No definite evidence of the cause of these cracks was found. (For preceding period see NYO-9058.) (auth)

3003 (TID-6863) STATISTICS OF FRACTURE MODES. Technical Report No. 2. D. Gücer and J. Gurland. Brown Univ., Providence. Oct. 1960. 22p. Contract AT(30-1)-2394. OTS.

A generalized theory of fracture statistics for engineering materials was developed for a combination of the "weakest-link" and independent (bundle) modes of fracture. The "weakest-link" approach to fracture problems was reviewed, and it was shown that the classical concept can be generalized to include more than one class of volume elements, each with its own fracture-strength distribution function. The classical fiber-bundle fracture statistics were applied to the strength distribution of cross-sectional slices of unit thickness of a cylindrical body. The distribution is normal for a large number of volume elements in the cross section. The implications of the two modes of fracture were demonstrated by assuming a Weibull type fracture-strength distribution of the volume elements. It was shown that in cylindrical bodies the "weakest-link" strength is a function of the volume and that the combined independent-fracture–weakest-link strength is a function of cross section and length. A fracture-arresting mechanism was introduced in the form of a crack-propagation function depending on the actual stress in the unbroken portion of the cross section. Using this mechanism, an intermediate case was developed where weakest-link and combined independent–weakest-link modes are operative. (auth)

3004 (TID-7502(Pts. 1 and 2)(Del. 2)) PROCEEDINGS OF THE METALLURGY INFORMATION MEETING HELD AT OAK RIDGE, APRIL 11-13, 1955. Oak Ridge National Lab., Tenn. June 1960. 975p. OTS.

Eighty-six papers on fundamental and developmental research were delivered at this meeting during 12 sessions. The papers covered the following subjects: physical metallurgy; reduction, refining, and recovery; and melting and fabrication. (W.L.H.)

3005 (WADC-TR-59-366(Pt.II)) THERMAL PROTECTION OF STRUCTURAL, PROPULSION, AND TEMPERATURE-SENSITIVE MATERIALS FOR HYPER-

SONIC AND SPACE FLIGHT. [Period covered]: July 1958 to September 1959. William P. Manos, Donald E. Taylor, and Anthony J. Tuzzolino. Chicago. Univ. Chicago Midway Labs. Dec. 14, 1959. 228p. Project No. 7360. Contract AF33(616)-6006. OTS.

Results are presented of an investigation intended to examine various phenomena applicable to the protection of materials subjected to severe thermal environments and to evaluate their effectiveness on the survival of materials now available. The heating experienced by materials in selected severe thermal environments is reviewed. The various phenomena that might be employed for protection are studied and evaluated analytically. Experimental tests were performed to aid in evaluation of certain phenomena, using the plasma discharge of a 1000-kw air-stabilized arc to provide a severe thermal environment. These results are reported, along with a correlation of the observed behavior with theory and previous tests. (See also WADC-TR-59-366(Pt.I).) (auth)

3006 (WADC-TR-59-432(Pt.II)) REFRACTORY INORGANIC MATERIALS FOR STRUCTURAL APPLICATIONS. [Period] covered: June 1959–June 1960. Harry A. Pearl, John M. Nowak, and Joseph C. Conti. Bell Aircraft Corp., Buffalo. June 1960. 95p. Project No. 7350. Contract AF33(616)-5930. OTS.

A process was developed for making simple and complex curvature geometric shapes from honeycomb ceramic-sandwich constructions. Final fired sections had apparent densities as low as 26 lb/ft^3. A simple mechanical method was developed for continuous fabrication of ceramic corrugated ribbon or sheet for making honeycomb cores. The core is flexible and machinable in its prefired condition. The skins are as easy to handle as paper. Alumina-silica paper impregnated with an alumina-silica slurry was used as a refractory model system for developing the fabrication techniques. The paper originally acts as a carrier but becomes an integral part of the fired refractory. The fabrication and processing methods are adaptable to refractory materials possessing higher strength and temperature stability. Other types of ceramic and metal-ceramic composites were investigated and evaluated. (auth)

3007 (WAPD-BT-20(p.91-110)) ELIMINATION OF PWR SUBASSEMBLY AND CLUSTER PICKLING. J. C. Helbling. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

The effects of eliminating the pickling operation normally employed on Zircaloy-2 PWR Seed 1 components prior to corrosion testing were investigated. Corrosion weight gains, hydrogen analysis, and metallographic methods were employed to evaluate the corrosion resistance of the three prior-to-welding surface conditions investigated. A black lustrous corrosion film proved to be the most satisfactory component condition for welding. (auth)

3008 (WCAP-1610) THERMOELECTRIC NUCLEAR FUEL ELEMENT MONTHLY PROGRESS REPORT NO. 25 COVERING THE PERIOD JULY 1960. G. R. Kilp, W. P. Blankenship, R. C. Goodspeed, R. A. Markley, and P. V. Mitchell. Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh. Aug. 10, 1960. 34p. Contract AT(30-3)-500. OTS.

A USeTe compound was melted in a sealed tantalum bomb in the first of a series of tests for preparation of stoichiometric samples of such compounds. Although the experiment was a qualified success, the material was completely melted with virtually no reaction with the tantalum. Expansivity data were secured for a USe compound in two temperature ranges between room temperature and 650°C. The new hot-pressing system for pelletizing thermoelectric materials is being put into service. Preliminary indications are that commercial-purity grades of PbTe could be used at considerable cost savings and with at least as high thermoelectric efficiencies as the top-purity grades yield. Curves are presented showing thermoelectric characteristics for swaged elements of $Bi_{0.1}Ge_{0.95}Te$, P and N type PbTe, and hot- vs. cold-swaged PbTe. An uninstrumented capsule containing P and N type PbTe pellets is to be irradiated at ETR soon. Based on a post-mortem of a prototype fission-fired device irradiated at WTR, a new device was readied with necessary improvements for successful irradiation there once operation is resumed. Several thermoelectric elements are in process of fabrication. Preinstrumentation is an important feature of the process. More data are being gathered on properties of insulators and thermoelectric materials. (See also WCAP-1545.) (auth)

3009 (CEA-tr-A-701) PROCÉDÉ D'OBTENTION DU BERYLLIUM. (Process for Producing Beryllium). Translated into French from German Patent 860 281/1949. Inventor: Gustav Jaeger. [Patent granted] Oct. 30, 1952. 12p.

A process for beryllium production is described in which a molten beryllium compound is electrolyzed with a mobile cathode. The electrolyte of $BeCl_2$ + NaCl in the ratio of 1:1 is kept at 800°C. The cathode is a continuous metal belt moving over rollers. (T.R.H.)

3010 (JPRS-6106) THE PRODUCTION OF ZIRCONIUM. E. (Ye.) K. Safronov and G. F. Ivanovskii (Ivanovskiy). Translated from Khim. Nauk. i Prom. 1, 505-11(1956). 20p. OTS.

Methods of zirconium preparation are outlined, and properties of this metal are discussed. Separation of zirconium from hafnium is detailed, and uses of zirconium and its compounds are examined. (J.R.D.)

3011 (NP-tr-488) PROBLEMS OF METALLOGRAPHY AND THE PHYSICS OF METALS. (Problemy Metallovedeniya i Fiziki Metallov Pyatyy Sbornik Trudov). PARTS I AND II. May 1960. Translated from a publication of the State Publishing House of Scientific Literature on Ferrous and Non-Ferrous Metallurgy, Moscow. 720p. OTS.

Articles are presented on the study of phase transformations in alloys, processes of hardening and softening, diffusion processes, and certain other problems. (W.L.H.)

3012 METALLURGY OF URANIUM. N. P. Galkin. Atomnaya Energ. 9, 270-81(1960) Oct. (In Russian)

The development of uranium metallurgy in the Soviet Union and abroad is reviewed. A short description is given of the technology of uranium metal production in the USA. Preparations of UO_2 and UF_4, the theory and practice of magnesium reduction, and the melt refining process are discussed. Problems in metal production from UF_6 enriched and depleted in U^{235} and the perspectives of uranium metallurgy are analyzed. (tr-auth)

3013 CONSUMABLE ELECTRODE MELTING OF REACTIVE METALS. S. J. Noesen (General Electric Research Lab., Schenectady, N. Y.). J. Metals 12, 842-9 (1960) Nov.

Most metallic elements can be vacuum arc melted. Those with low melting points and relatively low vapor pressures are not adaptable to consumable-electrode melting. The degree of purification achievable by this process is dependent, through thermodynamic and kinetic

considerations, on the time, temperature, and pressure relation existing in the arc zone and the molten pool during melting. The temperature is in turn dependent on the characteristics of the base metal making up the consumable electrode. At present, arc melting is the only commercially feasible method of producing large quantities of high-purity refractory metals and their alloys. The extremely coarse grain size, resulting from vacuum arc melting of refractory metals, represents the most serious shortcoming of the process, and is detrimental to the mechanical properties of the cast metal. Grain refinement can be obtained by deformation and recrystallization of the cast product, but the grain size characterized by powder-metallurgical products has not been achieved. (B.O.G.)

3014 GENERAL TRENDS IN THE USE OF URANIUM IN THE NUCLEAR INDUSTRY. M. Salesse (Centre d'Étude Nucléaire, Saclay, France). Métaux (Corrosion-Inds.) 34, No. 412, 5p.(1959) Dec. (In French) (CEA-1475)

It can be seen from a consideration of the development of the military and civil needs for uranium that, in the long run, the main outlet for the metal will be provided by its industrial applications. The technical uncertainties concerning the best method of producing atomic energy are still numerous and, in fact, reflect the hesitation in choosing one of two classes of fuel: that based on the metal and that based on the oxide. Four main factors should influence the choice: the neutron reactivity and the enrichment of the uranium; the operating temperature; the resistance to radiation effects; and the chemical stability. But in actual fact, when the choice for a particular use has to be made, it will be another type of factor, such as the cost and weight and space considerations which will determine the choice of either metallic uranium or uranium oxide reactors. (auth)

3015 APPLICATION OF ELECTROLYTIC PROCESSES TO TITANIUM AND ZIRCONIUM METALLURGY. M. Socci (Soc. Montecatini, Milan). Met. ital. 52, 547-50 (1960) Aug. (In Italian)

A comparison is made between the thermal and electrolytic methods for titanium and zirconium production. Some thermal methods are in industrial use, but electrolytic methods have not yet been industrially exploited. It is concluded that, at present, the Kroll reduction method with magnesium tetrachloride (or the more recent method with sodium tetrachloride) is the only feasible method technologically and economically. The electrolytic refining process, with which it is possible to obtain a very pure product from otherwise unusable scrap, is of great industrial interest. (auth)

3016 PRODUCTION OF LITHIUM BY IGNEOUS ELECTROLYSIS. C. Merli (Soc. Montecatini, Milan). Met. ital. 52, 565-9(1960) Aug. (In Italian)

The ores from which lithium is obtained are briefly mentioned, and the general physical and chemical characteristics of the metal are described. The uses of lithium in industry are summarized. The processes used for the production of lithium are described, and the principal operational data for the electrolytic cell are given. (auth)

3017 TECHNIQUES OF METAL EVAPORATION IN VACUUM. (REVIEW). M. I. Vinogradov. Pribory i Tekh. Eksp. No. 4, 3-13(1960) July-Aug. (In Russian)

Techniques for evaporating metal in a vacuum in order to produce condensed coating and cladding are discussed. Special attention is given to the installation and performance of vapor sources of nonvolatile metals. (tr-auth)

3018 DESCALING OF TITANIUM AND ZIRCONIUM AFTER HEAT TREATMENT. John Walter Pokorny (to Imperial Chemical Industries Ltd.). British Patent 851,719. Oct. 19, 1960.

An improved method for descaling titanium, zirconium, and their alloys after heat treatment is outlined. The scaled metal is treated with a hot alkali metal pyrosulfate, borofluoride, or a mixture of the two. When the heat treatment is carried out at ≥900°C, the best descaling bath is 80% sodium pyrosulfate and 20% sodium borofluoride. The scale may be hot-rolled before descaling to enable it to be removed more readily. Two examples of this method are given in which zirconium was descaled after annealing at 600°C and the resulting film removed by immersion in a $6HF/45HNO_3$ pickling bath at room temperature. (D.L.C.)

Corrosion

3019 (BMI-1459) DEVELOPMENT OF CORROSION-RESISTANT ALLOYS FOR USE AS CONTAINER MATERIALS FOR DECLADDING SOLUTIONS OR AS WELDING ALLOYS. Charles L. Peterson, David C. Drennen, Merritt E. Langston, A. M. Hall, and Walter K. Boyd. Battelle Memorial Inst., Columbus, Ohio. Aug. 8, 1960. 65p. Contract W-7405-eng-92. OTS.

Twenty-four experimental alloys were developed and evaluated as container materials or welding alloys for use with Sulfex and Niflex decladding solutions. Niflex solutions, which were more corrosive than Sulfex solutions to most of the experimental alloys, produced severe localized attack on weldments made on vacuum-melted Hastelloy F with the experimental alloys. However, several of the alloys, when self-welded, were not selectively attacked. Some of these showed a substantial improvement in resistance to the decladding solutions. The most promising alloys were based on either 45 wt. % nickel–22 wt. % chromium or 50 wt. % nickel–25 wt. % chromium, with at least 6 wt. % molybdenum, and 1 wt. % titanium, 0.6 wt. % manganese, 0.4 wt. % silicon, 0.02 wt. % carbon, and the balance, iron. The alloy most resistant to both solutions contained 6 wt. % molybdenum and 1 wt. % copper in the 50 wt. % nickel–25 wt. % chromium base. Its corrosion rate of 22 mils per month in Niflex, with no selective attack, was significantly lower than the 105 mils per month recorded for Hastelloy F. Even lower rates would be expected under the less stringent conditions of actual process operation. Indications are that more resistance might be obtained by increasing the chromium and nickel contents. (auth)

3020 (DP-521) AQUEOUS CORROSION OF ALUMINUM AT 260°C. Vascoe Whatley. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C. Oct. 1960. 12p. Contract AT(07-2)-1. OTS.

Ten experimental alloys of aluminum containing up to 4% nickel corroded uniformly, without intergranular attack, when exposed for 3 months to flowing deionized water at 260°C. The average penetration rates were between 1.4 and 1.9 mils per month. (auth)

3021 (HW-65350) AUTOCLAVE TESTING OF ZIRCALOY-2. R. A. Thiede. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. June 1, 1960. 58p. Contract AT(45-1)-1350. OTS.

The process for autoclaving Zircaloy-2 with various operating cycles in superheated steam or pressurized water is explained and evaluated for use with diverse fuel element types or reactor components. The effects of operating variables on autoclave film quality and defect detection are noted. The equipment required for safe operation is discussed, and approximate costs of autoclave vessels are shown. (auth)

3022 (KAPL-2000-11(p.IV.1-IV.3)) CORROSION AND COOLANT CHEMISTRY. H. F. Karnes. Knolls Atomic Power Lab., Schenectady, N. Y.

The Inconel corrosion and coolant technology data that were obtained for the TF-65 test loop are briefly summarized. (W.L.H.)

3023 (KAPL-2000-11(p.IV.3-IV.6)) CORROSION OF INCONEL IN HIGH-TEMPERATURE WATER. M. A. Powers and H. L. Tymchyn. Knolls Atomic Power Lab., Schenectady, N. Y.

A series of static autoclave tests was performed to study the effect of wetted surface-to-volume ratio and the composition of test containers. Annealed Inconel was exposed for 2000 hr at 600°F in deionized, deoxygenated water with the pH adjusted to 9.5 to 10.5 with LiOH in three tests. The results of the three tests are shown. Statistical analysis of the data shows that at the 99% level of assurance, there was no difference between the corrosion rates of Inconel in these three tests. (W.L.H.)

3024 (KAPL-2000-11(p.IV.6-IV.8)) CAUSTIC CRACKING OF INCONEL AND STAINLESS STEELS. M. A. Powers and H. L. Tymchyn. Knolls Atomic Power Lab., Schenectady, N. Y.

An accelerated test was developed to compare the relative resistance of Inconel and stainless steels to solutions of the hydroxides of lithium, potassium, and sodium. The tests were performed at 636°F and 2000 psi. (W.L.H.)

3025 (KAPL-2000-11(p.IV.8-IV.9)) CORROSION OF INCONEL WELD OVERLAYS IN HIGH-TEMPERATURE WATER. M. A. Powers and H. L. Tymchyn. Knolls Atomic Power Lab., Schenectady, N. Y.

A test program was initiated to evaluate the relative corrosion resistance of various nickel-base weld overlaying materials and to determine the number of layers of the materials necessary to obtain corrosion resistance comparable with that of Inconel. The results of the test indicate that the third layer of all the materials has a corrosion resistance comparable with that of Inconel in a static system. (W.L.H.)

3026 (KAPL-2000-11(p.IV.9-IV.10)) CORROSION OF CHROMIUM-PLATED INCONEL. M. A. Powers and H. L. Tymchyn. Knolls Atomic Power Lab., Schenectady, N. Y.

Chromium-plated and electrolyzed Inconel samples were coupled with other Inconel samples to form a crevice. The specimens were exposed to various conditions. After exposure the chrome-plated and electrolyzed surfaces were examined. It was concluded that both chromium plate and electrolyzed deposits should have adequate resistance to reactor waters. (W.L.H.)

3027 (KAPL-2000-11(p.IV.10-IV.11)) CORROSION OF BRAZING ALLOYS. M. A. Powers and H. L. Tymchyn. Knolls Atomic Power Lab., Schenectady, N. Y.

An investigation was initiated to investigate three brazing alloys (Ni–Cr–B, Mn–Ni, and Au–Ni) for joining Ni–Cr–Fe alloys such as Inconel. Ni–Mn alloy is not recommended for use in reactors; this recommendation is based on the results of these corrosion tests plus additional considerations on the ease of brazing and joint strengths. The Au–Ni braze is preferred over the Ni–Cr–B braze for out-of-core applications because of its ease of brazing and higher joint strength. (W.L.H.)

3028 (KAPL-2000-11(p.IV.11-IV.12)) CORROSION OF BRONZES AND BRASSES IN HIGH-TEMPERATURE WATER. M. A. Powers and H. L. Tymchyn. Knolls Atomic Power Lab., Schenectady, N. Y.

A series of 8-week corrosion tests was performed on aluminum bronze, manganese bronze, and silicon brass in 300, 400, and 500°F static, deoxygenated, deionized water with the pH adjusted to 9.5 to 10.5 with LiOH. Results are reported. (W.L.H.)

3029 (KAPL-2000-11(p.IV.12-IV.17)) CORROSION BEHAVIOR OF ZIRCONIUM-BASE DEVELOPMENT ALLOYS IN HIGH-TEMPERATURE AND HIGH-PRESSURE WATER AND STEAM. B. E. Dearing and A. M. Andrako. Knolls Atomic Power Lab., Schenectady, N. Y.

A program intended to produce a new zirconium-base cladding and structural alloy for use in water-cooled reactors is reported. The corrosion weight gain in 28 and 98 days in 680°F water is reported for a number of zirconium alloys. (W.L.H.)

3030 (KAPL-2000-11(p.IV.20-IV.22)) THE NATURE AND COMPOSITION OF OXIDE FILMS FORMED ON METAL SURFACES IN HIGH-TEMPERATURE WATER SYSTEMS. M. E. Jones. Knolls Atomic Power Lab., Schenectady, N. Y.

The oxide film on many specimens removed from the coolant systems of in-pile-loops was analyzed chemically and radiochemically. The primary purpose of these analyses was to obtain data for use with the computer codes that were devised for accessibility studies and predictions. The materials were types 304 and 347 stainless steel, Inconel, and Zircaloy-2. (W.L.H.)

3031 (KAPL-2000-11(p.IV.22-IV.24)) SYNTHETIC CRUDS. M. S. Bushey. Knolls Atomic Power Lab., Schenectady, N. Y.

In this program cruds were synthesized, studied, and applied to test-specimen surfaces for studies of heat transfer and hydraulic flow. (W.L.H.)

3032 (NRL-5506) HIGH TEMPERATURE OXIDATION OF IRON–CHROMIUM BINARY ALLOYS IN WATER VAPOR. PART 1. A PRELIMINARY STUDY OF THE MECHANISM OF OXIDATION OF IRON–CHROMIUM BINARY ALLOYS IN WATER VAPOR. C. T. Fujii and R. A. Meussner. Naval Research Lab., Washington, D. C. Apr. 28, 1960. 27p. Project RR-007-01-42-5406.

The oxidation of Cr–Fe alloys (Cr content of 5, 10, 15, 20, and 25 wt. %) in a water vapor–argon atmosphere was studied at 700, 900, and 1100°C. A mechanism for the oxidation process is suggested in the form of wüstite decomposition at the outer-inner scale layer boundary, giving rise to Fe^{2+} diffusion to the outer layer and O^{2-} diffusion to the alloy–oxide interface. (C.J.G.)

3033 (CEA-tr-A-731) RECHERCHE AU MOYEN D'UN POTENTIOMÈTRE STABILISATEUR DE LA TENDANCE À LA CORROSION INTERCRISTALLINE DES ACIERS AU CHROME NICKEL EMPLOYÉS EN ÉTAT DE PASSIVATION. (Research with a Potentiometer Stabilizer on the Tendency to Intercrystalline Corrosion of Chromium–Nickel Steel used in the Passivation State) M. Prazak. Translated into French from Werkstoffe u Korrosion 9, 517-19(1958). 10p.

A stabilizer potentiometer with a precision of 2 to 3 mv and which supplies up to 100 ma was used to regulate the potential in corrosion studies of 18-8 steel. The electrolyte used was 1N H_2SO_4 with 0.01% NH_4SCN. The samples were activated for 10 sec in the solution at −0.46 to 0.56 r and then left at +0.14 r for 3 min and examined microscopically. The use of the potentiometer stabilizer in these studies was an improvement over classical methods, especially for intercrystalline corrosion. The results are tabulated and discussed. (T.R.H.)

3034 SELECTIVE CORROSION OF INCONEL. R. Bakish and F. Kern (CIBA Ltd., Basel). Corrosion 16, 533t-4t(1960) Nov.

Details of a case of selective corrosion of Inconel and a tentative mechanism by which it proceeds are presented. Sheet, rod, and tube samples were tested in the as-received condition by complete immersion in a fused-salt bath. Tests were carried out at 800°C for up to 50 days. It was found that a layer of porous sponge-like material formed on the surface. Chromium and iron were preferentially leached out of these layers. (auth)

3035 CORROSION OF NUCLEAR POWER PLANT TUBE MATERIALS BY BOILER SLUDGE. E. Howells (Babcock and Wilcox Co., Alliance, Ohio), T. A. McNary, and D. E. White. Corrosion 16, 571t-7t(1960) Nov.

An investigation was made of the corrosion effects of a sludge accumulation on various pressurized-water nuclear-power-plant tubing alloys. The tests were performed in small, vertical heat exchangers in which the heat-transfer tubes were made of the test alloys and a thick layer of sludge was placed on the tube sheet. Tests were run for times up to 12 months in order to gain corrosion-rate information. Each unit was thoroughly examined by destructive metallographic methods. Inconel was found to be most resistant to the test environment with little corrosion effect in evidence. Type 347 stainless steel was next with surface etching and some random pitting to $2\frac{1}{2}$ mils deep. Croloy 16-1 was superior to Monel and carbon steel, and rated below Type 347 stainless because it suffered more general pitting. Monel was still more severely corroded with preferential attack to 11 mils occurring at crevice opening. Carbon steel suffered the deepest attack on all surfaces, which were severely roughened. (auth)

3036 FACTORS GOVERNING THE CORROSION TESTING OF ZIRCALOY-BASE FUEL ALLOYS. S. Kass and R. F. Gessner (Westinghouse Electric Corp., Pittsburgh). Corrosion 16, 581t-5t(1960) Nov.

Some of the factors governing the high temperature water and steam corrosion behavior of a Zircaloy-2 alloy containing 6.3 wt. % uranium were studied. Corrosion was found not to be influenced by sample size, marking methods, or precorrosion exposure surface condition. The data further show that the corrosion resistance is markedly influenced by heat-treatment, with the low-temperature treatment resulting in less corrosion than the high-temperature treatment. Tests were run on samples in 600°F water, 680°F water, and 750°F steam. (auth)

3037 STUDY OF MASS TRANSFER OF METAL AND ALLOYS IN LIQUID BISMUTH–LEAD EUTECTIC ALLOY. Takeshi Akutagawa and Kiyoyuki Ogawa. Nippon Kinzoku Gakkaishi 24, 256-60(1960). (In Japanese and English)

A study of corrosion and mass-transfer of 18-8 stainless steel, mild steel, 5% Al-Fe, croloy 5 Si, Monel, and nickel in liquid Bi-Pb eutectic alloy was conducted with a thermal convection loop. The change of structure in corroded samples and the precipitates of the cold part of the loop were examined by a microscope and the crystal structures of precipitates were studied by x-ray analysis. The results obtained were as follows: (1) Nickel and monel were completely mass-transferred. The corrosion loss was most remarkable in mild steel; in 18-8 stainless steel and 5% Al-Fe it was moderate, and in 18-8 Mo stainless steel and croloy 5 Si it was comparatively light. (2) Nickel and nickel-component in monel were mass-transferred and precipitated in the form of the hexagonal or pentagonal γ intermetallic compound in the loop, and a bamboo-leaf-like β intermetallic compound was observed on the surface of the liquid Bi-Pb eutectic alloy. (3) Nickel-rich intermetallic β has a Ni-As-type lattice and is expressed by Ni (Bi, Pb) in which the ratio of Bi to Pb is 2 to 1. (4) In 18-8 and 18-8 Mo stainless steel, the phase changes from γ to α, but in the latter the layer depth of phase change is smaller than 10μ, and a regular array of etch pits at 1μ intervals in the grain was observed near the surface of sample. (auth)

3038 INTERNAL CATHODIC PROTECTION. C. Plumpton, H. M. Powell, and C. Wilson. Nuclear Power 5, No. 55, 101-3(1960) Nov.

The majority of metals commonly used in engineering structures are liable to suffer from corrosion. Since the rate of corrosion may strongly influence the useful life of an industrial plant, standard design practice tends to require high safety factors coupled with complicated design procedures which allow for relatively easy replacement of corroded components. The metallic surface may be protected against corrosion by ensuring that current from the surrounding electrolyte flows into every point of the surface. This method, known as cathodic protection, involves the installation of suitable anodes in the electrolyte. Frequently a suitable combination of cathodic protection and the combination of cathodic protection and the application of an insulating coating gives economical and efficient protection. The mathematical theory of cathodic protection is derived. The design problems and techniques are discussed. Future prospects in the search for new materials which may prolong the life of plant installations are described. (B.O.G.)

3039 A CORROSION STUDY IN PROCESSING URANIUM ORE. I. I. Tingley and R. R. Rogers. Mines Branch Research Report R 65. Canada. Dept. of Mines and Technical Surveys. Mines Branch. Jan. 1960. 6p. $0.25.

Pitting corrosion was observed in pachucas of 316L and SAE-1025 steels where uranium ore powder adhered from grinding or leaching operations. A laboratory study was made of corrosion rate vs. pH, and it was found that corrosion occurred only at spots where pustules and filaments formed. The pitting area must be electrically in contact with a bare area which is in contact with the leach solution. An O_2 concentration cell was thus formed. The corrosion can be prevented by a sufficiently low sulfate content in the solution, a sufficiently high pH, prevention of solid deposits, prevention of O_2 cells by eliminating aeration, and using type 316L steel. (T.R.H.)

3040 CORROSION (TEN YEAR BIBLIOGRAPHY). OTS SELECTIVE BIBLIOGRAPHY. Office of Technical Services, Washington, D. C. Dec. 1959. 39p. (SB-401). OTS.

A 10-year bibliography of about 1000 reports listed in the OTS abstract journals U. S. Government Research Reports and Technical Translations on corrosion is presented. (J.R.D.)

Fabrication

3041 (ASC-TR-7-785) MOLYBDENUM ALLOY EXTRUSION DEVELOPMENT PROGRAM. First Interim Technical Progress Report [for] June 15, 1960–September 15, 1960. P. A. Santoli. Allegheny Ludlum Steel Corp. Research Center, Brackenridge, Penna. Oct. 1960. 147p. Project No. 7-785. Contract AF33(600)-40861.

Molybdenum extrusion technology and properties of the extruded alloys are reviewed. Industrial capacity for their production is discussed. 55 references. (C.J.G.)

3042 (BAW-1090) LIQUID METAL FUEL REACTOR EXPERIMENT. INDUCTION WELDING FOR REMOTE MAINTENANCE — FINAL REPORT. D. E. Dean. Babcock and Wilcox Co. Research Center, Alliance, Ohio. Mar. 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 134p. Contract AT(30-1)-1940. OTS.

The feasibility and techniques of induction welding for use in remote maintenance were successfully investigated. Sound butt welds were made in Croloy pipe ranging in size from 1.5-in. Sch 40 to 12-in. Sch 40. Joints were made without inert-gas shielding. Iron laminations mounted on the induction magnetic field improved both efficiency and uniformity of peripheral heating. Interruption of the heating cycle produced better fusion of the inner edges of the joint. Wall thickness of pipe to be welded is limited to 3/16 to 1/2 in. by heat penetration and upset problems using equipment with a 300-cycle frequency. A relative moment equal to the wall thickness is required between the parts being joined. (C.J.G.)

3043 (BAW-1100) LIQUID METAL FUEL REACTOR EXPERIMENT. INVESTIGATION OF BERYLLIUM WELDING TECHNIQUES FOR REACTOR PORT THIMBLE JOINTS. Paul C. Thys. Babcock and Wilcox Co. Research Center, Alliance, Ohio. Apr. 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 24p. Contract AT(30-1)-1940. OTS.

To measure the neutron level of the Liquid Metal Fuel Reactor (LMFR), a detector must be placed in a thimble and inserted into the graphite core assembly. The approximate dimensions of the thimble are: length, 11 ft; diameter, 3 in.; wall thickness, $\frac{1}{8}$ in. One end will be closed, the other joined to the vessel wall by a flange. The thimble was to be made of beryllium because (1) it would not necessitate an addition of fuel to maintain criticality when inserted into the core assembly, and (2) it has good corrosion resistance to molten bismuth. Beryllium tubing is not available in 11-ft lengths; therefore, two or more lengths must be joined. Since previous beryllium-to-beryllium welding has been unsatisfactory, a method of joining the lengths had to be developed. An end-cap joint was successfully welded using tungsten inert-gas procedures. Examinations showed no leakage or defects. Excellent facilities for handling beryllium and beryllium compounds have been provided, and a safe operating procedure based on AEC recommendations has been established. (auth)

3044 (HW-64629) NOVEL CERAMIC FUEL FABRICATION PROCESSES. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Apr. 15, 1960. 51p. Contract AT(45-1)-1350. OTS.

Novel approaches to nuclear-reactor fuel elements have emphasized the use of nonsintered ceramic fuels in a variety of cladding materials of various geometries. A special need existed for fabrication methods appropriate to plutonium-enriched or partially decontaminated recycled fuels. Equally important was the need for determination of the real operating limits of ceramic fuels. Methods for packaging nonsintered ceramic fuels include compaction by swaging, applied vibration, high-energy impact and explosion forming, isostatic pressing of selectively deformable containers, and, perhaps most simply, the encapsulation of loosely packed powders. Preirradiation-evaluation experiments and irradiation tests in support of these advanced fuel-element concepts are summarized. Experience with swaged and vibrationally compacted UO_2 includes fuel-element surface heat fluxes of approximately 1,350,000 Btu/hr-ft^2, fuel-core temperatures in excess of 2750°C, and exposures greater than 5×10^{21} nvt. Cold swaging and vibrational-compaction processes were used to fabricate full-core-length nonsegmented UO_2 fuel elements for the Plutonium Recycle Test Reactor. Details of these fabrication processes, yielding uniform fuel densities in the range 9.3 to 9.9 gm/cm^{-3}, are described. Statistically significant performance data from these fuel elements will be forthcoming after full power operation begins in late 1960. (auth)

3045 (HW-66043) INVENTION REPORT: HERMETICALLY SEALED CLOSURE ON A SHEATHED THERMOCOUPLE. Bert S. Kosut. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. July 12, 1960. 4p. Contract AT(45-1)-1350. OTS.

A procedure is described for welding a hermetically sealed closure on sheathed thermocouples to be used at high temperatures, and high pressures in a nuclear radiation zone. (C.J.G.)

3046 (NAA-SR-5291) URANIUM ALLOY FUEL ELEMENT FABRICATION DEVELOPMENT FOR HNPF CORE I. S. M. Cobb. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Nov. 1, 1960. 55p. Contract AT-11-1-GEN-8. OTS.

A fuel element, consisting of a cluster of stainless-steel-clad sodium-bonded, U–10 wt.% Mo fuel rods, has been proposed for the first core loading in the Hallam Nuclear Power Facility. Analytical data on density, soundness, chemical composition, dimensions, and surface finish were obtained from more than 100 heats of fuel slugs which were vacuum cast in graphite molds. The quality levels obtained were satisfactory, and casting was proven to be a feasible fabrication method for U–10 wt.% Mo fuel slugs. Extrusion and liquid pouring were both investigated as methods of handling sodium to bond fuel rods. The extrusion technique was shown to be impractical because of difficulty in supplying a sufficient volume of sodium to fill the rod. Satisfactory bonding was obtained using the liquid technique. Two full-scale fuel-element mock-ups were fabricated. Each element contained 19 fuel rods located by spacers made from spot welded strips and enclosed in a process tube. Assembly problems encountered in the first mock-up were corrected by modifying the fuel-rod spacers. Methods were developed for safe handling of the fuel rods and other long (15 ft) components. The second mock-up demonstrated that the fuel element was suitable for fabrication and assembly. Physical testing was performed on fuel-rod end closures, cladding support springs, the variable-orifice thermocouple, and the fuel-rod spacers. The end closures and support springs were shown to have adequate strength. The thermocouple functioned well at temperatures and flexure conditions simulating reactor operation. A minimum material thickness was determined for the fuel-rod spacers. (auth)

3047 (NMI-4801) COEXTRUSION OF ZIRCALOY-CLAD U–2 w/o Zr ROD FOR THE EBR-I MARK III CORE LOADING. H. F. Sawyer. Nuclear Metals, Inc., Cambridge, Mass. Apr. 30, 1958. 53p. Contract AT(30-1)-1565. Sponsor Agreement No. S-27. OTS.

Technical data are given concerning the fabrication of Zircaloy-clad U–2 wt. % Zr alloy rod from extrusion billets. The development of high-yield extrusion billets for fabricating the enriched core and blanket rod is described. (auth)

3048 (NOTS-TP-2421) THE EXPLOSIVE WORKING OF METALS. John Pearson. Naval Ordnance Test

Station, Inyokern (China Lake), Calif. Feb. 4, 1960. 54p. (NAVORD-7033).

Basic methods for the explosive forming, sizing, shaping, cutting, compacting, and welding of metals and alloys are discussed. Fundamental aspects of pressures, forces, and velocities pertinent to explosive metal-working operations are discussed. Material behavior patterns are considered. (C.J.G.)

3049 (NP-9350) A SURVEY OF ULTRA FINE POWDERS AND POWDER MIXTURES. Final Report. Frank W. Heck, Donald P. Ferriss, Frances H. Clark, and Gregory J. Comstock. Stevens Inst. of Tech., Hoboken, N. J. Powder Metallurgy Lab. Nov. 30, 1956. 28p. For Freeman (M. W.) Co. Contract NOa(s)54-519.

The compaction of pyrophoric iron powders and iron powders containing aluminum, molybdenum, beryllium, and copper in air was investigated. Satisfactory compacts were attained when the powders were cooled to −25°F. A method of reducing oxygen content to < 0.02% without sintering was devised. Densities and tensile strengths were determined for the powders. (C.J.G.)

3050 (NP-9375) DEVELOPMENT OF TECHNIQUES FOR PRODUCING BERYLLIUM STRUCTURAL SHAPES. PHASE I. First Interim Technical Report [for] August 24, 1960 to September 24, 1960. B. H. Hessler and E. E. Weismantel. Beryllium Corp., Reading, Penna. 33p. Contract AF33(600)-41959.

Methods for producing various structural shapes from beryllium by roll-forming are reviewed. Those factors in billet and strip production (through the deformation and thermal process) which might affect properties of roll-formed shapes are discussed. (C.J.G.)

3051 (ORO-316) FUEL-BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Quarterly Report No. 5 [for] May 1, 1960 to July 31, 1960. R. H. Baskey. Clevite Corp. Mechanical Research Div., Cleveland. Sept. 2, 1960. 30p. Project No. 50224 G. Contract AT(40-1)-2557. OTS.

The fabrication experiments being performed were designed to attain a uniform deformation in the frame, clad, and core. Fabrication techniques were modified when producing dummy fuel plates from uranium-bearing Fiberglas core material. Cladding this core material with Alclad 6061 resulted in a significant improvement toward eliminating the ripple effect experienced on many of the earlier plates. Alclad 6061 dummy fuel plates containing uranium-bearing Fiberglas core sections displayed strength retention properties at elevated temperatures. At 600°F, commercial 6061 aluminum has a tensile strength of 4500 psi while Alclad 6061 dummy fuel plates have exhibited a tensile strength of 11,400 psi. Experiments were conducted to establish the feasibility of extruding Fiberglas-reinforced aluminum. The material from extrusions made at 900 and 1100°F was not acceptable for further fabrication. A series of experiments demonstrated that aluminum-coated Fiberglas can be rolled directly into sheet. It had a density of 97.6% of theoretical density. (auth)

3052 (WADD-TR-60-607) FUNDAMENTAL STUDIES ON THE MECHANISM OF ULTRASONIC WELDING. Period covered: March 1959–July 1959. W. J. Lewis, J. N. Antonevich, R. E. Monroe, and P. J. Rieppel. Battelle Memorial Inst., Columbus, Ohio. June 1960. 50p. Project No. 7351. Contract AF33(616)-6268.

The fundamental mechanisms of ultrasonic welding and the application of this process to the joining of various heat-resistant materials were investigated. Ultrasonic spot welds made in various combinations of heat-resistant alloys generally confirmed the results of previous work with these alloys. The findings indicate that ultrasonic welding is not suitable for the production of aircraft-quality spot welds in the heat-resistant and dissimilar-metal combinations included in this program. General limitations on the use of this process in its current state of development can be established from the work conducted. It is apparent that as a material's hardness increases, and the ratio of tensile strength to yield strength decreases, weldability by the ultrasonic process decreases. (auth)

3053 (WAPD-211) EUTECTIC-DIFFUSION-BONDING OF PLATE-TYPE FUEL ELEMENTS CONTAINING CERAMIC FUEL. R. A. Wolfe, F. O. Bingmam, R. L. Fischer, R. C. Lacerte, and E. F. Losco. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh. Oct. 1960. 114p. Contract AT-11-1-GEN-14. OTS.

A process was developed for fabricating plate type fuel elements consisting of ceramic fuel wafers contained within a bonded, compartmented Zircaloy-clad structure. The method of bonding Zircaloy to Zircaloy, known as eutectic-diffusion-bonding, involves the formation of a molten layer between the Zircaloy surfaces by means of eutectic reaction at elevated temperatures, followed by diffusion of the bonding agent, or eutectic-forming agent, into the adjacent Zircaloy to achieve a continuous Zircaloy-matrix bond. A large number of fuel-element samples were fabricated by this process using various combinations of the bonding parameters, such as type and amount of bonding agent and time and temperature of bonding. The bonded samples were evaluated by metallographic examination, corrosion testing, internal pressure testing of individual fuel compartments, and other test procedures. An optimum technique based on the results of these evaluations was established for eutectic-diffusion-bonding of the plate type fuel elements. (auth)

3054 (WAPD-BT-20(p.111-23)) DEVELOPMENT OF TECHNIQUES FOR LARGE-SCALE ELECTROLESS COPPER PLATING OF ZIRCALOY PLATE-TYPE FUEL RECEPTACLE COMPONENTS. V. V. DeGeorge. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

The use of copper-eutectic diffusion bonding for the manufacture of plate type oxide-bearing fuel elements (investigated for use in the manufacture of PWR Core 2 fuel elements but abandoned in favor of the pressure-bonding process) necessitated the placement of a copper bonding agent at the diffusion bonding interface. A program to establish methods of achieving this by electroless deposition of copper on pilot-run quantities of fuel-receptacle plates and to establish methods of inspection of the copper deposit was undertaken. The required aims were achieved by establishing methods to control all pertinent surface preparation and plating variables and by the use of an x-ray fluorescence inspection instrument. (auth)

3055 (YAEC-144) FABRICATION OF YANKEE CORE I PROTOTYPE FUEL ELEMENT. M. D'Amore. Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh. May 1960. 52p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

Fuel tubes which were 93 in. long were compartmented at approximately 15 in. intervals by crimping the fuel tube into a groove on the periphery of a disk which was located within the tube, thus locking the disk in position. Experimental fuel rods produced using this technique were successfully brazed into a subassembly of 25 fuel rods. The disks inside the fuel tubes were plated with a Ni–P brazing

alloy to produce a disk-to-tube brazed joint during subassembly brazing. A manufacturing process line was equipped, and fabrication of a prototype Yankee fuel-element assembly was completed. The fuel element consisted of an assembly of nine brazed subassemblies with a total of 305 fuel rods. Techniques and tooling were developed for manufacturing of fuel-element assemblies for the Yankee reactor core. (auth)

3056 (CEA-tr-R-851) RÉPARTITION DU CARBONE DANS LE VOISINAGE DES JOINTS SOUDÉS DES ACIERS AUSTÉNITIQUES DU TYPE 18-9. (Distribution of Carbon in the Vicinity of Welded Joints in 18-9 Austenitic Steel). N. V. Ul'yanova (Oulianov) and V. V. Sagalovich (Sagalovitch). Translated into French from Metallovéd i Obrabotka Metal. No. 7, 2-6(1957). 16p.

An autoradiographic technique using C^{14} was used to study the macroscopic properties and carbon distribution in weld-joints and neighboring regions of 18-9 nickel–chromium austenitic steels. Immediately after welding a certain enrichment of carbon was observed in the base metal within a narrow region (0.7 mm) near the weld, adhering to the line of fusion. Tempering at 650 to 850°C for 2 to 5 hr increased the nonuniformity of carbon distribution. Austenitization increases corrosion resistance because of the more uniform distribution of carbon. A later reheating of austenitic joints does not cause redistribution. (T.R.H.)

3057 (JPRS-3924) INVESTIGATION OF METAL FLOW DURING UPSETTING WITH BACKING RINGS BY MEANS OF THE PRINCIPLES OF VARIATIONS. I. Ya. Tarnovskii (Tarnovskiy), O. A. Ganago, and R. A. Vaysburd. Translated from Izvest Vysshikh Ucheb. Zavedenii Chernaya Met. No. 5, 55-60(1960). 12p. OTS.

Metal flow in backing rings during upsetting in forging was investigated. (C.J.G.)

3058 (JPRS-5931) PROBLEMS OF SAFETY DURING THE CASTING AND PROCESSING OF TITANIUM ALLOYS. (Voprosy Bezopasnosti pri lit'ye i Obrabotke Splavov Titana). B. M. Zlobinskii (Zlobinskiy), I. I. Barber, P. I. Razumova, and N. V. Manuev (Manuyev). Translated from Bezopasnost Truda v Prom. No. 6, 20-1(1960). 8p. OTS.

The safety hazards of casting and fabricating titanium and titanium alloys are discussed. (C.J.G.)

3059 (NP-tr-489) THE MACHINING OF HARDENED STEELS. (Mekhanicheskaya Obrabotka Zakalennykh Staley). L. M. Reznitskii (Reznitskiy). July 1960. Translated from a publication of the State Publishing House of Scientific-Technical Literature on Machine Building, Moscow–Leningrad. 455p. OTS.

This volume is devoted to the machining of hardened structural-alloy steels. It sets forth the results of investigations and data on progressive industrial experience in the turning, end-milling, drilling, rose and flute reaming, and cutting of threads in hardened steels. It contains practical recommendations on tool design and geometry selection and on cutting routines. (W.L.H.)

3060 CRACKING IN WELDED JOINTS OF AUSTENITIC STEEL IN C.E.G.B. POWER STATIONS. F. E. Asbury, B. Mitchell, and L. H. Toft (Central Electricity Research Labs., [London]). Brit. Welding J. 7, 667-78(1960) Nov.

Difficulties encountered with welded joints in austenitic steel used for the main steam systems of power stations are described. An 18% Cr–12% Ni–1% Nb steel was employed, and cracks occurred in the heat-affected zones of the welds. Examination of cracked welds showed that the heat-affected zones were in a hardened condition. Tensile tests were carried out to investigate the causes of hardening. It was found that the heat-affected zones would be strained and hardened by precipitation of niobium carbide with an associated fall in ductility, particularly at low rates of straining. (auth)

3061 FIRST SET OF FUEL ELEMENTS OF THE EL-3 REACTOR. J. A. Stohr and M. Englander. Bull. inform. sci. et tech. (Paris) No. 42, 2-10(1960) July-Aug. (In French)

Four sets of fuel elements used in the EL-3 Reactor have shown the excellent behavior of uranium–molybdenum alloys with molybdenum concentration from 1.5 to 10%. Some data on the behavior of the fuel elements with respect to the burn-up are given. The highest burn-up obtained was about 7000 Mwd/ton. The limitation on the burn-up was caused only by the loss of reactivity. No deformation of the fuel elements was observed. Some data on the fabrication of uranium–molybdenum fuel elements are given. (tr-auth)

3062 "NUCLEAR CLEAN" WORKSHOP AT ERITH. Engineer 210, 675-6(1960) Oct. 21.

Strict manufacturing control is needed to exclude from the gas circuit of a graphite-moderated gas-cooled reactor any materials which might adversely affect performance. This requirement led to the construction of a "nuclear clean" workshop at the Erith Engineering Works of The General Electric Company, Ltd., of England. Unwanted materials can be grouped as neutron absorbers; dusts capable of becoming highly radioactive; and materials that have an adverse metallurgical or chemical effect. Special control is exercised from the time the parent metal enters the works and is maintained on each component throughout its manufacture, culminating in a final operation of cleaning, preserving, and packing. A description is given of the workshop and its operation. (B.O.G.)

3063 PWR FUEL ELEMENT MANUFACTURE. TECHNIQUES EVOLVED BY WESTINGHOUSE. M. D'Amore (Westinghouse Electric Corp., Pittsburgh). Nuclear Eng. 5, 501-4(1960) Nov.

Approximately 3,500,000 uranium dioxide ceramic pellets were used in fabricating the 23,142 fuel rods for the Yankee reactor core. The fuel rods are braze-bonded together with a series of spacer ferrules to form 684 subassemblies, which are made up in groups of nine into the 76 assemblies weighing 910 lb each, thus forming the core structure. A fuel rod consists of a column of cylindrical uranium dioxide pellets contained within a 93-in. long stainless-steel tube, interrupted at 15-in. intervals by stainless-steel disks joined to the inside of the tube. (auth)

3064 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE PRODUCTION OF LOW PERMEABILITY CARBON. Donald Arthur Boyland (to General Electric Co.). British Patent 846,483. Aug. 31, 1960.

Commercial high-permeability graphite may be converted into the low-permeability form by passing a hydrocarbon gas through it at a high temperature (800 to 1200°C) to give a carbonaceous deposit and heating it to a higher temperature (~3000°C) to drive off volatile matter and to graphitize the carbon deposit. In this way it is possible to reduce the permeability by a factor of 1000. The respective effects of the various hydrocarbon gases, e.g., methane, propane, and acetylene, are examined. Sometimes the process is slowed by the formation of a thin surface film; in many cases, however, the low permeability offered by this surface film is satisfactory. (D.L.C.)

3065 IMPROVEMENTS IN OR RELATING TO THE COATING OF CLOTH, PLASTIC OR OTHER PLIABLE MATERIAL FOR THE PROTECTION OF PERSONNEL FROM RADIATION. Werner Treuherz, Stanley Wolstenholme, and Stanley Hallowell (to Everglades Ltd.). British Patent 851,479. Oct. 19, 1960.

Protective sheeting material for radiation protection against x rays, γ radiation, etc., may be manufactured in the form of aprons, helmets, gloves, screens, and shields comprising three layers. The inner layer contains the protective material (e.g., lead powder) whereas the two outer layers include a plastic free from protective material which may be laid on cloth, glass fiber, or some other fibrous material. The plastic offers a number of advantages over cloth, which was used in the past; three of these advantages are economy, strength, and washability. In the preferred embodiment of the invention, the plastic is polyvinyl chloride; and the protective layer is made from a paste containing polyvinyl chloride and lead powder. Formulas and procedures are given for the manufacture of such sheeting material. (D.L.C.)

3066 ELECTRO-PLATING URANIUM WITH PROTECTIVE METALS. (to United Kingdom Atomic Energy Authority). British Patent 853,521. Nov. 9, 1960.

Methods are presented for electroplating uranium with protective metals. Nickel may be used to coat uranium and then a copper coating used to cover this nickel coating, or copper may be used alone. Lead, tin-impregnated copper, and copper coatings are corrosion-resistant, and procedures are given for their application over nickel and copper coatings. (D.L.C.)

3067 NICKEL COATINGS AND METHOD OF APPLYING. (to United Kingdom Atomic Energy Authority). British Patent 853,522. Nov. 9, 1960.

Methods are presented for electrodepositing nickel coatings on uranium and covering these nickel coatings with other coatings, e.g., chromium, copper, and aluminum–silicon. The uranium is first cleaned and etched with an aqueous solution containing chloride ions and then electroplated with nickel. The electroplated uranium may then be heated to 700 to 800°C to alloy the nickel with uranium and thus improve their adherence. Examples are given in which aluminum–silicon, chromium, and copper coatings are deposited on nickel coatings of uranium. (D.L.C.)

Properties and Structure

3068 (60-RL-2410-M) PHYSICAL NATURE OF PLASTIC FLOW AND FRACTURE. J. J. Gilman. General Electric Co. Research Lab., Schenectady, N. Y. Apr. 1960. 90p.

A review of current knowledge concerning the mechanisms of plastic flow and fracture is presented. Included are discussions on the crystallography of dislocation motion, kinetics of dislocation motion, dislocation nucleation and multiplication, dislocations and macroflow, and crack nucleation and propagation. (auth)

3069 (AD-234925) LEAD SHIELDING. Interim Report No. 3 [for] November 1, 1959 to December 31, 1959. Storchheim Research and Development Corp., Woodside, N. Y. Dec. 31, 1959. 53p. Contract NOas-59-6249-c.

Ultimate tensile strength, elongation, yield strength, modulus of elasticity, stress-rupture, creep, x-ray diffraction, corrosion, and other tests were performed on lead strip directly rolled from lead powders. The results generally indicated the powder-rolled product to be superior to the cast-wrought product. A statistical analysis as to the effect of time on the properties of the finished strip was concluded. The effect of rolling speed and lubrication methods on properties of the lead strip was investigated. The results indicated that rolling speed is a vital parameter and is related to particle size. (C.J.G.)

3070 (AD-236160) CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH PROGRAM. Quarterly Progress Report No. 2 [for] January 1960 to April 1960. J. A. Coffman, G. M. Kibler, T. R. Riethof, and A. A. Watts. General Electric Co. Flight Propulsion Lab. Dept., Cincinnati. Apr. 25, 1960. 46p. Contract AF33(616)-6841.

Factors that aid in the carbonization of plastics are reviewed. Thermogravimetric studies showed that synthetic phenol-formaldehyde resins give higher coke yields than do commercial varieties (57 and 45%, respectively). Of the cellulose base materials studied, polyacrylonitrile gave the highest coke yield (38%). Construction of the arc-image furnace and the fluid-bed apparatus was completed. Vapor pressure studies were conducted on TaC at 2300 to 3300°K. The average heat of vaporization of graphite was determined to be 173.8 kcal/mole. Emissivity measurements were made for nickel and tungsten in the visible wave-length range and for TaC in the visible and infrared range at 1460 to 2800°K. (C.J.G.)

3071 (AD-239333) ELEVATED TEMPERATURE CHARACTERISTICS OF 347 STAINLESS STEEL AND H-7213 MICARTA (ASTROKON). Summary Report. S. Y. Lu, Marc Trubert, and William A. Nash. Florida. Univ., Gainesville. Engineering and Industrial Experiment Station. June 1960. 62p. Contract DA-01-009-ORD-656.

The mechanical properties of type 347 stainless steel and of type H-7213 Micarta at rapidly attained elevated temperatures were studied. Samples were heated to 2200°F in 15 sec, then loaded in tension at the strain rate of 1.0 in./in./sec. Other samples were heated to 2200°F at a rate of 200°F/sec with various initial stresses present in the specimen; heated to 2200°F in 15 sec, followed by various lengths of time in which the temperature is held constant prior to loading at a constant strain rate; and subjected to thermal cycling between 2200 and 400°F with various initial stresses present in the specimen. The effects of various heating rates and peak temperatures on the number of cycles to fracture were also studied along with the tensile characteristics of type H-7213 Micarta when loaded to fracture at a strain rate of approximately 0.25 in./in./sec. (auth)

3072 (ARF-2187-3) DUCTILE BERYLLIUM ALLOYS. Bimonthly Report No. 3 for Period January 1 to February 29, 1960. Frank A. Crossley and R. J. Van Thyne. Illinois Inst. of Tech., Chicago. Armour Research Foundation. Mar. 15, 1960. 9p. Contract NOas 60-6036-c.

An envelope type microstructure prepared by liquid-phase sintering is being investigated as a means of producing ductile beryllium alloys. Results for seven new compacts are reported. A germanium addition was found to be highly beneficial to a silver-matrix compact as well as for aluminum-matrix compacts. A Be–65 Ag–1 Ge (75 vol. % beryllium) compact was reduced 70% by cold pressing. The microhardness of beryllium particles in several highly plastic compacts was found to be from 90 to 150 higher in DPH values than for relatively low-plasticity compacts. Plastic deformation decreased the apparent hardness of the "hard" beryllium grains. (auth)

3073 (BAW-1095) LIQUID METAL FUEL REACTOR EXPERIMENT—EFFECT OF OPERATING CONDITIONS ON CROLOY 2-1/4 AND CROLOY 1-1/4. W. R. Foley, J. S. Makris, and W. E. Leyda. Babcock and Wilcox Co. Research Center, Alliance, Ohio. Mar. 1, 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 48p. Contract AT(30-1)-1940. OTS.

Croloy 2¼ (2¼ Cr–1 Mo) and Croloy 1¼ (1¼ Cr–½ Mo) were tested under LMFRE operating conditions to determine the effects of heat-treatment on the ductility transition temperature of these alloys. Some specimens were tested in liquid bismuth with additives to determine creep-rupture and tensile properties. (auth)

3074 (BAW-1197) LIQUID METAL FUEL REACTOR EXPERIMENT, GRAPHITE EVALUATION PROGRAM. A. L. Lowe, Jr., comp. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. and Babcock and Wilcox Co. Research Center, Alliance, Ohio. June 1960. 109p. Contract AT(30-1)-1940. OTS.

The mechanical, physical, and nuclear properties of three grades of graphite were tested. The density, modulus of elasticity, and flexural strength compared favorably with standard nuclear-grade graphites. Cemented joints fabricated for a large moderator block displayed mechanical and corrosion properties equal to the base material. Although not completely evaluated, graphite-to-metal seals were found to be serviceable. In each grade of graphite, pore interconnections caused some absorption of bismuth; the length of time a given sample was exposed to bismuth had a minor effect on the degree of absorption. The pore interconnections also affected the seepage of bismuth through graphite; the greater the number of pores the higher the seepage rate. Further, it was shown that seepage decreases with exposure time and increases as the temperature is increased. Investigation of impregnants to fill the graphite pore spaces indicated that formation of a metal carbide from metal impregnation was most promising. (auth)

3075 (BNL-624) DIFFUSION OF XENON THROUGH ALUMINUM AND STAINLESS STEEL. A. W. Castleman, F. E. Hoffmann, and A. M. Eshaya. Brookhaven National Lab., Upton, N. Y. July 1960. 11p. OTS.

Studies on the diffusion of xenon through aluminum, stainless steel, and the Piqua fuel-element cladding (0.143-in.-thick finned Al+ 0.0005-in. Ni bond) by a radioactive-tracer technique are reported. Xenon was not found to diffuse through aluminum as thin as 0.010 in. at 295 to 473°C. Stainless-steel specimens (0.020 in. thick) showed no evidence of xenon diffusion up to 610°C. A maximum value for xenon permeability through the Piqua fuel-element cladding is given; however, since the experimentally determined values lack correlation with temperature, they appear to be anomalous. (auth)

3076 (CEA-1399) ÉTUDE DE LA TEMPE ET DU REVENU A LA TEMPÉRATURE ORDINAIRE D'ALLIAGES URANIUM–CHROME, URANIUM–FER ET URANIUM–MOLYBDENE, A FAIBLE TENEUR EN ÉLÉMENT D'ALLIAGE. Thesis submitted to Univ. of Nancy. (Study of the Quenching and Subsequent Return to Room Temperature of Uranium–Chromium, Uranium–Iron, and Uranium–Molybdenum Alloys Containing Only Small Amounts of the Alloying Element). Jean Delaplace. France. Commissariat a l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 52p.

By means of an apparatus which makes possible thermal pretreatments in vacuo, quenching carried out in a high-purity argon atmosphere, and simultaneous recording of time-temperature cooling and thermal-contraction curves, the transformations which occur in uranium-chromium, uranium-iron and uranium-molybdenum alloys during their quenching and subsequent return to room temperature were studied. For uranium-chromium and uranium-iron alloys, the temperature of which the γ-β transformation starts varies very little with the rate of cooling. For uranium-molybdenum alloys containing 2.8 at. % molybdenum, this temperature is lowered by 120°C for a cooling rate of 500°C/mn. The temperature at which the β-α transformation starts is lowered by 170°C for a cooling rate of 500°C/mn in the case of uranium-chromium alloy containing 0.37 at. % chromium. The temperature is little affected in the case of uranium-iron alloys. (auth)

3077 (CEA-1582) DIAGRAMMES DE VARIATIONS D'ENERGIE LIBRE DE FORMATION DES COMPOSES METALLIQUES—APPLICATIONS. (Diagrams of the Variations in the Free Energy of Formation of Metallic Compounds). R. Darras and H. Loriers. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 17p.

The variations in the standard free energy produced during the formation of the principal simple metallic compounds were calculated as a function of the temperature from recently published data and are presented in convenient diagram form. Their usefulness in metallurgy is illustrated by some possible applications. (auth)

3078 (DMIC-116R) DESIGN INFORMATION ON 5Cr–Mo–V ALLOY STEELS (H-11 AND 5 Cr–Mo–V AIRCRAFT STEEL) FOR AIRCRAFT AND MISSILES. (REVISED). R. J. Favor and W. P. Achbach. Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio. Sept. 30, 1960. 50p. Contract AF18 (600)-1375. (PB-151072-R). OTS.

A summary of design information pertinent to the use of the 5Cr–Mo–V (H-11 type and aircraft quality) alloy steels in aircraft and missile applications is presented. Heat-treatment, melting practice, and corrosion protection are considered. Manufacturing problems such as machining, forming, and joining also are briefly discussed. Data on the elevated-temperature mechanical properties of these steels were collected and evaluated. (auth)

3079 (HW-63574) STUDIES ON THE OXIDES OF PLUTONIUM. T. D. Chikalla. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Dec. 1959. 53p. OTS.

For presentation at the 2nd International Conference on Plutonium, at Grenoble, France, April 19th to 22nd, 1960.

The existence of a continuous series of solid solutions formed during sintering was established for the system UO_2–PuO_2. A linear relation between lattice parameter and composition was found to exist. Extensive sinterability data on the isomorphous compounds UO_2 and PuO_2 and their intermediate compositions were obtained. The effect on sintered density of temperature, time, and concentration for both physical additions of PuO_2 and additions of UO_2–PuO_2 solid solutions to UO_2 were studied. Melting-point studies were performed on PuO_2, UO_2, and solid solutions of the two compounds. The liquidus for the PuO_2–UO_2 system was obtained. Thermal-expansion coefficients for PuO_2 and UO_2 were obtained at temperatures up to 1000°C. Irradiation-effects tests were performed on a number of specimens of both high and low density of UO_2–PuO_2. (auth)

3080 (HW-66196) THERMAL REDISTRIBUTION OF HYDROGEN IN ZIRCALOY-2 PROCESS TUBES. R. E. Westerman. General Electric Co. Hanford Atomic

Products Operation, Richland, Wash. Aug. 1960. 19p. Contract AT(45-1)-1350. OTS.

The distribution of absorbed hydrogen within Zircaloy-2 process tubes under various thermal gradient conditions was investigated. A summary of the basic equations that were developed to predict the behavior of systems exhibiting the thermal diffusion phenomenon is given. (W.L.H.)

3081 (NAA-SR-5507) FINELY DISPERSED PHASES IN URANIUM–MOLYBDENUM TERNARY ALLOYS. David Kramer. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Nov. 1, 1960. 18p. Contract AT-11-1-GEN-8. OTS.

Uranium-base metallic reactor fuels show good resistance to swelling if the gas bubble concentration remains as high as 10^{13} cm^{-3}. Precipitate particles of a finely dispersed second phase can presumably act as bubble nucleation sites. A uranium-base alloy containing a finely dispersed second phase having a submicron particle size and spacing therefore holds promise of superior resistance to swelling during irradiation. Finely dispersed phases were produced in U–Mo alloys with ternary additions of Sn and Si after suitable heat treating. In certain alloys particles as small as 0.2 μ, having densities as high as 10^{13} cm^{-3} and showing good thermal stability at 670°C, have been realized. Small changes in heat-treating temperatures were found to influence strongly the distribution of the precipitated phase. (auth)

3082 (NAA-SR-Memo-3103) GRAPHITE DILATION UPON EXPOSURE TO LIQUID SODIUM. J. J. Gill. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Aug. 25, 1958. 3p. OTS.

Graphite dilates anisotropically on uptake of liquid sodium. There is apparently no significant difference in dilation between the graphites ranging in density from 1.6 to 2.0. It is recommended that in fabrication of dummy element cans the clearances between the graphite and can walls be 1.2 and 2% in the parallel and perpendicular directions to the extrusion axis, respectively, for the CS type graphite. (J.R.D.)

3083 (NAA-SR-Memo-5588) A COMPILATION OF ROOM TEMPERATURE AND 1200°F PROPERTIES OF METALLIC MATERIALS WITH SPECIFIC REFERENCE TO THEIR USE AS FUEL CLADDING IN SODIUM COOLED THERMAL REACTORS. H. E. Kline. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Aug. 16, 1960. 39p. OTS.

A compilation is presented of room temperature and 1200°F properties of a large number of alloys which might be considered for use in a sodium-cooled reactor. Specific consideration is given to the use of such materials as fuel cladding. The arbitrary basis for property comparison is type 304 stainless steel. The study was made of 10 classes of alloys. These alloys are alloy steels, ferritic stainless steels, austenitic stainless steels, iron and iron–aluminum alloys, precipitation-hardening stainless steels, austenitic superalloy, nickel-base alloys; cobalt-base alloys; copper-base alloys, and refractory metals and alloys. (W.L.H.)

3084 (NMI-1240) PRELIMINARY SURVEY OF MECHANICAL PROPERTIES AND PHASE RELATIONSHIPS IN SEVERAL BERYLLIUM BINARY ALLOYS [FOR] JULY 1, 1958–JUNE 30, 1959. F. M. Yans. Nuclear Metals, Inc., Concord, Mass. Sept. 8, 1960. 41p. Contract AT(30-1)-1565. OTS.

Attempts were made to fabricate Be–Zn alloys (maximum zinc content approximately 1 wt. %) by powder-metallurgy techniques. Free zinc was detected in the microstructure after solutionizing at temperatures up to 1100°C. No Be–Zn intermetallic compounds were detected. Dezincification of the beryllium alloy did not become serious until about 700°C. No solid solubility of zinc in beryllium was noted, since the beryllium lattice parameter remained unchanged by zinc addition and/or solutionizing heat treatments. The tensile properties of these alloys were at best erratic and generally poorer than those of pure beryllium. (auth)

3085 (NP-9214) MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS. PART 1. HIGH-TEMPERATURE PROPERTIES OF A MOLYBDENUM-3 PER CENT THORIUM ALLOY. PART 2. EVALUATION OF A COLUMBIUM–ZIRCONIUM–TITANIUM CLADDING ALLOY. G. W. P. Rengstorff, G. S. Root, F. C. Holden, and R. I. Jaffee. Battelle Memorial Inst., Columbus, Ohio. Sept. 9, 1960. 36p. Contract Nonr-1512(00).

In the first section of this report, a study was made of the high-temperature properties of a Mo–3% Th alloy to determine whether this alloy should be rejected as valueless or a full research program should be proposed. Results of this investigation show that thorium should be studied more intensively as an alloying addition for molybdenum. In the second section, an evaluation is presented of the oxidation behavior, mechanical properties, and cladding properties of Nb–55 at. % Zr–5 at. % Ti alloy. (W.L.H.)

3086 (NP-9274) BERYLLIUM CRACK PROPAGATION AND RELATED STUDIES. SPECIAL BIBLIOGRAPHY. K. D. Carroll, comp. Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif. Aug. 24, 1960. 45p. (SB-60-30). OTS.

A compilation is presented of information pertinent to surface cracks that develop in beryllium when it is subjected to bending loads, its recovery from stress and bending, and fracture or crack propagation to catastrophic failure. (W.L.H.)

3087 (ORO-331) SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Monthly Progress Report No. 10 [for] September 1 through September 30, 1960. K. M. Taylor and C. H. McMurtry. Carborundum Co. Research and Development Div., Niagara Falls, N. Y. Oct. 13, 1960. 2p. Contract AT(40-1)-2558. OTS.

Several synthesis experiments were carried out to provide a stock of U_3Si_2, powders for fabrication of test specimens. Initial thermal-expansion characteristics were determined on U_3Si_2 bars. High densities were obtained in the preparation of UN bodies. Thermal-expansion tests were made on bars of UN with a high-density silicon carbide tube dilatometer in a flowing argon atmosphere. (W.L.H.)

3088 (PWAC-301) BRITTLE FRACTURE; DUCTILE-BRITTLE TRANSITIONS: AN ANNOTATED BIBLIOGRAPHY. Elizabeth A. Cernak and Eugene J. Delgrosso, comps. Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn. Sept. 15, 1960. 91p. Contract AT(11-1)-229. OTS.

An annotated bibliography containing 549 references on the brittle fracture of metals is presented. References are also given on cleavage and ductile fractures, ductile-to-brittle transition, ductility, and brittleness of metals. The bibliography is limited to the period 1945 through Mar. 1960 with the references arranged alphabetically by title. A subject index is provided. Sources used in compiling this bibliography include ASM Review of Metal Literature and Nuclear Science Abstracts. (auth)

3089 (TID-6512) PROPERTIES OF MATERIALS AT HIGH TEMPERATURES. Technical Progress Report [for]

October 16, 1959 to October 15, 1960. John L. Margrave. Wisconsin. Univ., Madison. 41p. Contract AT(11-1)-835 OTS.

Five papers are included. Separate abstracts were prepared for each paper. (W.L.H.)

3090 (TID-6512(Paper 1)) VAPOR PRESSURES OF PLATINUM METALS. I. PALLADIUM AND PLATINUM. Lloyd H. Dreger and John L. Margrave. Wisconsin. Univ., Madison. Paper 1 of PROPERTIES OF MATERIALS AT HIGH TEMPERATURES. 7p.

Langmuir free-evaporation rates for palladium and platinum samples of high purity establish the equilibrium vapor pressures and the heat of sublimation at 298°K:

$$\underline{\text{Pt}} \quad \log P_{mm} = 10.566 - \frac{29.128}{T}$$

$$\Delta H^0_{298} = 135.22 \pm 0.85 \text{ kcal/mole}$$

$$\text{b.p.} = 4{,}100 \pm 100°\text{K}$$

$$\underline{\text{Pd}} \quad \log P_{mm} = 9.075 - \frac{19.425}{T}$$

$$\Delta H^0_{298} = 91.0 \pm 0.8 \text{ kcal/mole}$$

$$\text{b.p.} = 3280 \pm 100°\text{K}$$

(auth)

3091 (TID-6512(Paper 2)) VAPOR PRESSURE OF PLATINUM METALS. II. RHODIUM AND IRIDIUM. Preliminary Report. Lloyd H. Dreger and John L. Margrave. Wisconsin. Univ., Madison. Paper 2 of PROPERTIES OF MATERIALS AT HIGH TEMPERATURES. 4p.

Langmuir free-evaporation studies of rhodium and iridium wires at high temperatures have established the sublimation pressures as follows:

$$\underline{\text{Rh}} \quad \log P_{mm} = 10.343 - \frac{28.757}{T}$$

$$\Delta H^0_{298} = 134.2 \pm 0.8 \text{ kcal/mole}$$

$$\text{b.p.} = 3850 \pm 100°\text{K}$$

$$\underline{\text{Ir}} \quad \log P_{mm} = 10.511 - \frac{30.614}{T}$$

$$\Delta H^0_{298} = 142.3 \pm 0.6 \text{ kcal/mole}$$

$$\text{b.p.} = 4200 \pm 100°\text{K}$$

(auth)

3092 (TID-6512(Paper 4)) SUBLIMATION AND DECOMPOSITION STUDIES ON BORON NITRIDE AND ALUMINUM NITRIDE. Lloyd H. Dreger, V. V. Dadape, and John L. Margrave. Wisconsin. Univ., Madison. Paper 4 of PROPERTIES OF MATERIALS AT HIGH TEMPERATURES. 14p.

The behavior of solid boron nitride (BN) and AlN was studied at high temperatures by measurement of the rate of weight loss into a vacuum from a surface of known area, i.e., the Langmuir technique. Both nitrides appear to decompose to the elements in the range 1500 to 2000°K but at rates only about 2.5×10^{-3} of those predicted from thermodynamics. No evidence for gaseous BN or AlN molecules was observed. The heat of formation of BN(s) as deduced from an oxygen bomb combustion by Van Artsdalen and coworkers does not agree with that obtained from a third-law treatment of equilibrium measurements of the N_2 pressure over BN at high temperatures by Lorenz and Woolcock. It appears that the true value for the heat of formation lies in the range -55 ± 5 kcal/mole. (auth)

3093 (TID-6512(Paper 5)) THE HIGH-TEMPERATURE DECOMPOSITION OF TiN. Preliminary Report, July 28, 1960. Lloyd H. Dreger and John L. Margrave. Wisconsin. Univ., Madison. Paper 5 of PROPERTIES OF MATERIALS AT HIGH TEMPERATURES. 3p.

The decomposition of TiN was studied over the temperature range 1727 to 2099°K using the Langmuir free-evaporation technique. The decomposition was observed to occur to the elements $2TiN_{(s)} \rightarrow 2Ti_{(g)} + N_2$. (auth)

3094 (TID-6752) STUDY OF FACTORS INFLUENCING DUCTILITY OF IRON–ALUMINUM ALLOYS. Monthly Letter report No. 5. George P. Rauscher, Jr., Frank C. Perkins, and Joseph F. Nachman. Denver. Univ. Denver Research Inst. Oct. 7, 1960. 10p. Contract AT(11-1)-742. OTS.

Deformation mechanisms in Fe–Al single crystals were studied, and observations regarding deformation structures are discussed. In surface-preparation studies, a polishing technique was developed which requires only that the chemical bath temperatures be controlled and that the bath be agitated. Bath composition is given, and results obtained with Thermenol treated by this technique are included. (J.R.D.)

3095 (TID-6764) THE METALLOGRAPHIC PREPARATION OF PLUTONIUM AND ITS ALLOYS AT LOS ALAMOS. K. Imlah and E. M. Cramer. Los Alamos Scientific Lab., N. Mex. Feb. 18, 1958. Decl. Sept. 12, 1960. 14p. OTS.

Techniques for preparation of metallographic samples of plutonium and plutonium alloys are described. Photomicrographs are shown to illustrate the use of these techniques. It is noted that binary plutonium alloys with 52 elements, including rare-earth metals, alkaline-earth metals, noble metals, and most of the more common elements were metallographically prepared and examined using these methods. (J.R.D.)

3096 (TID-6794) EFFECT OF TEMPERATURE ON YIELDING IN SINGLE CRYSTALS OF THE HEXAGONAL Ag–Al INTERMETALLIC PHASE. Technical Report No. 1. J. Mote, K. Tanaka, and J. E. Dorn. California. Univ., Berkeley. Materials Research Lab. June 1, 1960. 41p. Project No. 46. Contract AT(11-1)-34. OTS.

Oriented single crystals of the intermediate hexagonal phase containing silver plus 33 at. % aluminum were tested in tension over a wide range of temperatures. Slip was observed to take place by the $\{0001\}\langle 11\bar{2}0\rangle$ and $\{\bar{1}100\}\langle 11\bar{2}0\rangle$ mechanisms; fracture took place across the $\{\bar{1}100\}$ plane and twinning occurred by the $\{10\bar{1}2\}$ mechanism. Basal slip exhibited a strong yield point over the range from 77 to 450°K, the upper resolved shear stress having the exceptionally high value of 10,500 psi over this entire range of temperatures. The critical resolved shear stress for prismatic slip decreased from 48,000 psi at 4.3°K to 23,000 psi at 170°K (Region I) following which it decreased slowly to 21,500 psi at 475°K (Region II); from 475 to 575°K (Region III), the critical resolved shear stress decreased precipitously to 2000 psi; and from 575 to 750°K (Region IV) it decreased less rapidly to a low value of about 500 psi. Prismatic slip in Region I was shown to be controlled by the thermally activated mechanism of nucleation and growth of kinks in dislocations lying in Peierls potential troughs. In Region II for prismatic slip, as well as for all of the observed region of basal slip where yield point phenomena were observed and over which the critical resolved shear stress for slip was insensitive to temperature, the critical resolved shear stress was shown to be determined by short range ordering (or clustering). (auth)

3097 (USNRDL-TR-442) RADIOCHEMICAL STUDIES OF THE FAST NEUTRON FISSION OF URANIUM-235 AND URANIUM-238. L. R. Bunney, E. M. Scadden, J. O. Abriam, and N. E. Ballou. Naval Radiological Defense Lab., San Francisco. July 8, 1960. 11p.

Radiochemical studies utilizing ion exchange chromatography were made of heavy fission products of U^{235} and U^{238} with two spectra of fast neutrons. The lower energy neutron spectrum used was very similar to an undegraded fission spectrum. The higher energy neutron spectrum had a broad maximum near 8 Mev and was thought to be somewhat like the neutron spectra of thermonuclear weapons. A comparison is made between the results of this work and the literature values for low-energy fission. (auth)

3098 (WADC-TR-59-597(Pt.III)) THERMOELASTIC RESPONSE OF AIRCRAFT STRUCTURES TO HIGH-INTENSITY THERMAL RADIATION, INCLUDING PREHEAT. PART III. CORRELATION OF EXPERIMENTAL STRAIN DISTRIBUTIONS WITH ANALYSIS. Irving Frank and Richard E. Portnoy. Allied Research Associates, Inc., Boston. Apr. 30, 1959. 60p. Project No. 1350. Contract AF33(616)-5001. (AD-237924)

A laboratory investigation of the response of full-scale aircraft components subjected to simulated supersonic nuclear weapon conditions was performed. A thermal-strain correlation is presented comparing the experimentally determined thermal strains for the substructures of F-84F stabilators with theoretical strain values. The experimental strain values apply to F-84F stabilators with and without preheat subjected to transient heat inputs on one surface. The theoretical strain results are determined by means of an elementary one-dimensional thermal-stress analysis. Some major factors affecting the accuracy of the correlation are discussed, and graphs comparing the experimental and theoretical strain values are presented. In addition a one-dimensional thermal-stress analysis which includes the effect of skin buckling for a box-section subjected to a nonuniform heat input is presented. Critical strain for the onset of buckling in the skin is found as a function of box-section geometry, temperature gradients and edge conditions. The results of the analysis are presented in graphical and analytical form. A representative calculation for the tip deflection of the entire stabilator under thermal loading is presented, and a comparison is made with observed values. (auth)

3099 (WADC-TR-59-655) RESEARCH AND DEVELOPMENT ON THE EFFECTS OF HIGH PRESSURE AND TEMPERATURE ON VARIOUS ELEMENTS AND BINARY ALLOYS. Period [covered] July 1, 1958–September 30, 1959. J. S. Harvey, L. Kaufman, S. A. Kulin, A. Leyenaar, and H. Udin. Manufacturing Labs., Inc., Cambridge, Mass. Sept. 1, 1959. 98p. Project No. 7351. Contract AF33 (616)-5996. (AD-240794).

High-pressure high-temperature apparatus capable of subjecting test specimens to 100,000 atm. at temperatures above 1500°C was designed and constructed. High hydrostatic pressure lowers the temperature of martensitic transformations in Fe–Ni alloys and expands the temperature range of the γ loop in the Fe–Ni system. The precipitation hardening process in both Al–Cu and Cu–Be alloys is inhibited and modified when carried out at high hydrostatic pressure. The use of pressure during heat-treatment of various steels results in transformation products different in structure from those normally obtained and also retards the tempering reactions. High-pressure high-temperature processing of the Pt–C, Pd–C, and Ni–C systems results in the formation of a new phase. Preliminary experiments indicate that the Ti–N phase diagram is significantly modified by pressure. (auth)

3100 (WADC-TR-59-702(Pt.I)) MECHANICAL PROPERTIES OF SELECTED ALLOYS AT ELEVATED TEMPERATURES. [Period] covered: July 1958–September 1959. Harry A. Pearl, George F. Kappelt, and Edmund J. King. Bell Aircraft Corp. Engineering and Research Labs., Buffalo. Mar. 1960. 269p. Project No. 7381. Contract AF33(616)-5760. (AD-237298).

Materials in plate and bar form were subjected to tension, compression, bearing, and shear stresses at various temperatures after exposure times of ½, 10, 100, and 1000 hr at selected test temperatures from ambient room to 1500°F. The materials studied included AM 355, PH15-7Mo, HK31-H24, A 286, Udimet 500, and Inconel X. In general the test results show that most of the material properties, regardless of the type of stress imposed, decrease with temperature and time. Time of exposure was not as effective in lowering the properties as the temperature. The A 286 alloy showed mechanical properties higher after prolonged exposure due to aging at some temperatures. The sharp drop-off in properties that the other alloys exhibited at the higher temperatures was not characteristic of the A 286 alloy. Since mechanisms of failure are different, precise data under a given stress can be obtained only by testing under the desired conditions. Comparisons between alloys are made only where the temperature range of operation is common to both. (auth)

3101 (WADC-TR-59-747) RESEARCH AND DEVELOPMENT ON THE EFFECTS OF HIGH PRESSURE AND TEMPERATURE ON VARIOUS ELEMENTS AND BINARY ALLOYS. [Period covered]: June 1958 to October 1959. E. W. Goliber, K. H. McKee, J. S. Kasper, J. E. Hilliard, J. W. Cahn, and V. A. Phillips. General Electric Co. Metallurgical Products Dept., Detroit and General Electric Co. Research Lab., Schenectady, N. Y. Oct. 15, 1959. 70p. Project No. 7351. Contract AF33(616)-5995. OTS.

An investigation was made of the effect of pressure on the properties and kinetics of transformation in various alloy systems. Many of the experiments were exploratory and yielded no evidence for irreversible changes with pressures of up to 100,000 atm at elevated temperatures. However, a shift was observed in the γ loop of the Fe–Cr system from 12.5 to about 20% Cr. Evidence for a similar shift in the γ loop of the Fe–Al system was also found. Pressure-heat treatment of a tool steel gave a refinement of the austenite grain size and an improvement in the distribution of carbides. An apparatus for x-ray-diffraction analysis at pressures up to 35,000 atm was constructed, and observations were made on the bismuth I and II transition. In the kinetic experiments it was found that pressure markedly decreases the transformation rate of austenite to pearlite and the precipitation in the systems: Al–Cu, Cu–Be, Pb–Sn, and Au–Ni. (auth)

3102 (WADD-TR-60-316) BINARY AND TERNARY DIAGRAMS. Period covered: May 1, 1958 to March 15, 1960. Elmars Ence, Paul A. Farrar, and Harold Margolin. New York Univ., New York. Coll. of Engineering. Mar. 15, 1960. 82p. Project No. 7351. Contract AF33(616)-5704. OTS.

The titanium-rich corner of the Ti–Al–Cr system has been reinvestigated from 600 to 1400°C (up to 40 wt. % aluminum and 32 wt. % vanadium). Partial isothermal sections have been constructed at 1400, 1200, 1100, 1000, 800, and 600°C. The phases encountered in the portion of the system investigated are α, β, γ_{Ti_3Al}, δ_{Ti_2Al}, ϵ_{TiAl}, and $TiCr_2$. A miscibility gap in the β field is produced by the interaction

of the $\beta + \delta_{Ti_2Al}$ and the $\beta + TiCr_2$ fields. The Ti–Al–V system has been reinvestigated from 50 to 100 wt. % titanium and from 500 to 1400°C, using x-ray-diffraction and metallographic techniques. Isothermal sections were delineated at 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, and 1400°C. Vertical sections at 2, 4, 6, 10, and 16 wt. % aluminum; 2, 4, 6, 10, and 16 wt. % vanadium and 90 wt. % titanium were constructed. The phases encountered in the portion of the system reinvestigated were α, β, γ_{Ti_2Al}, δ_{Ti_2Al}, and ϵ_{TiAl}. (auth)

3103 (WAPD-BT-20(p.23-38)) A STUDY OF THE SINTERING BEHAVIOR OF SOME URANIUM DIOXIDE POWDERS. J. C. Clayton and L. Berrin. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

The sintering behavior of some 35 well-characterized UO_2 powders was studied. Pressing pressures and sintering time, temperature, and atmosphere were varied. Definite relationships were found between the sinterability of the powders and their preparation method, surface texture, particle size and shape, and aggregate size and distribution. (auth)

3104 (WAPD-BT-20(p.39-51)) A STUDY OF THE TENSILE PROPERTIES OF ZIRCALOY-2 AT VARIOUS STAGES OF FABRICATION. J. G. Goodwin. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

This work was performed to determine changes which occur in the tensile properties of Zircaloy-2 at various stages of fabrication from ingot to cold-rolled strip. Material size, test direction, and the effect of round and flat specimens on the tensile properties were studied at both room temperature and 600°F. It was found that the type of specimen had little effect on the strength properties but did influence ductility; both size of material and test direction influenced the results of strength measurements. (auth)

3105 (WAPD-BT-20(p.53-9)) MECHANICAL AND PHYSICAL PROPERTIES OF DIRECT MELTED SPONGE HAFNIUM PLATE. E. H. Sayell and W. B. Haynes. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

In view of the potential savings that can be realized by direct-melting hafnium sponge to ingot, thereby eliminating the crystal-bar operation, a continuing effort is being expended on evaluating hafnium plate. Preliminary tests were conducted on 10 sponge plates to determine whether this material would meet the specifications required for reactor use. Although results showed the test material to be below specification, much was learned, and the tests reported here served to indicate promising areas for product improvement. (auth)

3106 (AEC-tr-4273) A STUDY OF THE TRANSFORMATIONS THROUGH ANNEALING OF THE γ BODY CENTERED CUBIC PHASE OF URANIUM–MOLYBDENUM ALLOYS. (Étude des Transformations par Revenu de la Phase γ Cubique Centreé des Alliages Uranium–Molybdène). Hubert Mikaïloff. France. Commissariat à l'Énergie Atomique, Paris. Translated from report CEA-1270, June 23, 1959. 82p. (Includes original, 60p.). JCL or LC.

Original submitted as a thesis to Collège de France, Paris. Conservatoire National des Arts et Métiers.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 11973.

3107 (AEC-tr-4308) STUDY OF TRANSFORMATION PROCESSES IN URANIUM–MOLYBDENUM ALLOYS OF 0.5 TO 4% BY WEIGHT OF MOLYBDENUM. (Étude des Processus des Transformations dans les Alliages Uranium–Molybdène de Teneur 0,5 à 4% en Poids de Molybdène). Jeanne Lehmann. A translation of report CEA-1261, June 9, 1959. 59p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 11972.

3108 (AEC-tr-4310) DETERMINATION OF ENTHALPY AND THERMAL CAPACITY OF BERYLLIUM OXIDE IN THE TEMPERATURE RANGE FROM 1200–2820°K. V. V. Kandyba, P. B. Kantor, R. M. Krasovitskaya, and E. N. Fomichev. Translated by Lydia Venters (Argonne National Lab.) from Doklady Akad. Nauk S.S.S.R. 131, 566-7(1960). 4p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 16640.

3109 (HW-tr-20) EFFECT OF SMALL AMOUNTS OF METALLIC IMPURITIES ON ALUMINUM CASTINGS. R. Irmann. Translated by B. B. Lane from Aluminium 34, 128-30(1958). 7p. JCL.

Information on the effects of impurities on aluminum castings is reviewed. Effects of additives on properties of cast alloys are tabulated. (J.R.D.)

3110 (JPRS-3928) INVESTIGATION OF CHANGES IN THE FINE INTRAGRANULAR STRUCTURE OF A COMPLEX COBALT-BASE ALLOY (K40NKhM) DURING PLASTIC DEFORMATION AND ANNEALING. Yu. A. Skakov and Ya. S. Umanskiĭ (Umanskiy). Translated from Izvest. Vysshikh Ucheb. Zavedeniĭ, Chernaya Met. No. 5, 150-8 (1960). 14p. OTS.

Changes in the intragranular structure of a Cr–Co–Fe–Mn–Mo–Ni alloy during plastic deformation and annealing were investigated. (C.J.G.)

3111 (NP-tr-501) THE HALL CONSTANT OF BINARY TITANIUM–NIOBIUM ALLOYS. (Konstanta Kholla Binarnykh Splavov Titana s Niobiyem). N. V. Grum-Grzhimaĭlo (Grum-Grzhimaylo). Translated from Zhur. Neorg. Khim. 3, 1715-16(1958). 3p. OTS.

Investigations concerned with diffusion in Nb–Ti alloys are described. Sample preparation and apparatus design are described, and results obtained in measuring the Hall constant in relation to the composition are given. (J.R.D.)

3112 (NP-tr-508) EFFECT OF HARDENING TEMPERATURE ON PROCESS OF SHORT-RANGE ORDER DEVELOPMENT IN Ni–Cr ALLOY. (Vliyaniye Temperatury Zakalki Na Protsess Obrazovaniya Blizhnego Poryadka v Splave Ni–Cr). L. E. (Ye.) Popov and G. I. Karpov. Translated from Doklady Akad. Nauk S.S.S.R. 129, 1028-30(1959). 12p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 8765.

3113 (RAE-Lib-Trans-880) ELASTIC PROPERTIES OF ARTIFICIAL GRAPHITE. (Elastische Eigenschaften von Kunstgraphit). R. Arnold. Translated by H. C. Ranson from Z. angew. Phys. 11, No. 5, 179-83(1959). 11p. (AD-235491).

The plastic deformation of artificial graphite is shown to be of the order of magnitude of 0.02%. The modulus of elasticity was found to be equal and constant in tensile and compression tests. Poisson's ratio was found to be 0.22. The ratio of thickness to length of a test specimen is discussed with regard to its effect on the determinations of elastic modulus. (auth)

3114 DIFFRACTION BY ONE- AND TWO-DIRECTION PERIODIC ANTIPHASES OF THE TYPE $AuCu_3$. P. Perio and M. Tournarie (Centre d'Études Nucléaires, Saclay, France). Acta Cryst. 12, 1032-8(1959) Dec. (In French) (CEA-1460)

A theory is presented describing the diffraction by periodic antiphase structure in ordered $AuCu_3$ type alloys. The treatment is rigorous and allows for noninteger periods. The general shape of the amplitude distribution in any 001 reciprocal plane can be determined without any computation and is given for the six possible configurations of two-direction antiphase structures. (auth)

3115 ONE-DIRECTION PERIODIC ANTIPHASES IN THE SYSTEM AuCu. P. Perio and M. Tournarie (Centre d'Études Nucléaires, Saclay, France). Acta Cryst. 12, 1044-7(1959) Dec. (In French) (CEA-1461)

A study has been made of the antiphase structure of ordered alloys of the AuCu type. The interpretation presented by earlier workers is shown to be somewhat inadequate and an alternative explanation based upon a composition modulation inside each antiphase domain is put forward. (auth)

3116 RECRYSTALLIZATION IN COLD-ROLLED URANIUM. G. Ya. Sergeev, V. V. Titova, and L. I. Kolobneva. Atomnaya Energ. 9, 104-9(1960) Aug. (In Russian)

The influence of rolling and α-phase annealing on the structure and mechanical properties of uranium was investigated in uranium ingots rolled in the γ phase and tempered in the β phase. Fine-grain recrystallized uranium has a higher stability than the initial large-grain uranium. Approximate recrystallization diagrams at 5 to 40% compression and tempering at 350 to 650°C are plotted. Recrystallization depends slightly on the initial condition of the material. Data are given on the recrystallization processes. An admixture of 0.1 wt. % molybdenum strongly retards the recrystallization process and increases the stability of fine-grain uranium by ~20%. (tr-auth)

3117 MAGNETIC STRUCTURE OF THE ALLOY $MnAu_2$. André Herpin, Pierre Mériel, and Jacques Villain. Compt. rend 249, 1334-6(1959) Oct. 12. (In French) (CEA-1348)

The magnetic structure of $MnAu_2$ was determined by a neutron diffraction method. All the magnetic moments of the atoms in the same plane perpendicular to the quaternary axis are parallel; in this plane the magnetic moments of the atoms in the two neighboring planes make an angle of 102° between them. This helicoidal antiferromagnetic structure can be foreseen theoretically. (auth)

3118 STRENGTHENING PROCESSES IN SOLID SOLUTIONS OF Ni–Cr–Al AND Ni–Cr–W. M. P. Arbuzov, M. P. Krulikovskaya, and V. G. Chernyĭ (Inst. of Metal Physics, Academy of Sciences, Ukrainian SSR). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 170-4(1960). (In Russian)

The results are presented of x-ray investigations of true compression intensity and fine crystalline structure (distortion of the lattice ($\Delta a/a$) and mosaic domains) of alloys during strengthening and deformation process. The obtained data are plotted and analyzed. It is shown that variations in σ_{comp}, H_{RA}, ($\Delta a/a$), and D for Ni–Cr–Al and Ni–Cr–W alloys are similar. It is also shown that basic strengthening takes place at 20 to 30% deformation and mosaic domain crushing at 5% deformation. (R.V.J.)

3119 EFFECTS OF PLASTIC DEFORMATION ON PHASE TRANSFORMATIONS IN NICKEL–SILICON STEELS. Yu. A. Sysuev, E. V. Vasil'eva, and M. A. Krasil'nikova (Inst. of Physics and Tech., Gor'kii State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 218-22(1960). (In Russian)

Plastic deformation in silicon and nickel alloyed steel with an initial structure of $\alpha + Fe_3C$ was studied and magnetograms of possible phase transformations were prepared. Under deformation the cementite transforms into carbide XFe_2C (Curie point θ = 260 to 265°) which becomes unstable at temperatures above 400°C and disappears at 600°C. Comparisons after deformation and annealing confirm a reduced rate of graphitization in steel deformed by surrounding irregular compression. (tr-auth)

3120 RADIATION ENERGY TRANSFER AND THERMAL CONDUCTIVITY OF CERAMIC OXIDES. D. W. Lee and W. D. Kingery (Massachusetts Inst. of Tech., Cambridge). J. Am. Ceram. Soc. 43, 594-607(1960) Nov.

The heat-transfer mechanisms in several ceramic oxides were investigated from room temperature to 1250°C. The conductivity of normal sintered porous polycrystalline oxides results from phonon conduction, and results agree with theoretical expectations for the effect of impurities, structure, and temperature dependence. Single crystals, glasses, and low-porosity aggregates show deviations from the expected phonon conduction which are attributed to a second mechanism of heat transfer, namely, photon conduction. Measurements of photon conduction are related to infrared transmission, structure, and conditions of the measurements. Photon conduction can be a significant portion of the total heat conduction at high temperatures; however, for normal polycrystalline ceramic oxides of porosities greater than 2%, this contribution is small. (auth)

3121 TENSILE AND SHORT-TIME CREEP PROPERTIES OF N-155 ALLOY SHEET. Eugene C. Bernett (Marquardt Corp., Van Nuys, Calif.). J. Eng. Ind. 82, 283-302 (1960) Nov.

The special test equipment and procedures developed for the evaluation of ultrashort-time elevated-temperature mechanical properties of materials are described. The tensile and high-stress creep data obtained for Haynes N-155 alloy sheet are reported. At rapid strain rates, the high-temperature tensile strengths were up to 300% higher than those obtained at conventional testing speeds. At high temperatures and high stress levels creep rates were shown to be extremely rapid, and, in most cases, the creep strength became a critical factor. The application of rapid-strain-rate tensile data and high-stress creep data in short-life designs is discussed. (auth)

3122 PROPERTIES AND USES OF SINTERED ALUMINUM POWDER. D. Buttinelli (Università, Rome) and G. de Gregorio. Met. ital. Atti notiz. 15, 3-13(1960). (In Italian)

A general description is given of the fabrication of sintered aluminum powder, and its mechanical, physical, chemical, and nuclear properties are reviewed. The effects of irradiation on these properties are discussed with respect to the use of sintered aluminum powder in organic-cooled reactors. (auth)

3123 KINETICS OF THE DETERIORATION OF REFRACTORY METALS DURING CREEP. S. T. Kishkin and E. V. Polyak. Metalloved. i Termichesk. Obrabotka Metal. No. 9, 2-6(1960) Sept. (In Russian)

The behavior during creep of hardened commercial Ni–Cr base alloys was studied by means of vacuum metallography. It was found that a loss of strength was caused by the formation of microscopic cracks in perpendicular direction to the tensile force. With the extension of the duration of the test, the number of the cracks increased considerably, leading ultimately to the complete deterioration of the strength of the alloy. The process took place in two stages: first a gradual crack formation was noticed at the grain boundary, followed by a fast loss of strength. The

alloy that showed a 10 to 15% elongation at fracture displayed embrittlement after creep with an elongation of only 1 to 3%. In cast alloys, the cracks appeared at later stages of the creep testing since their formation was blocked by carbide precipitation. Removal of surface defects by electropolishing increased considerably the time required for the appearance of cracks, thus increasing the useful lifetime of the alloy. (TTT)

3124 INFLUENCE OF THE STRUCTURE ON THE REFRACTORY CHARACTER OF ALLOYS. L. B. Getsov, D. F. Zhirnov, K. I. Terekhov, and M. G. Taubina. Metalloved. i Termichesk. Obrabotka Metal. No. 9, 12-16(1960) Sept. (In Russian)

The effect of macrocrystalline regions formed during the forging of temperature-resistant steels on their refractory properties was studied by comparing their behavior with those of steels in which grain growth was artificially induced, reaching 1 to 2 mm in one case and 3 to 5 mm in another. Results showed that the presence of such macrocrystalline regions reduced considerably the long-range refractory character of the alloy although the short-range mechanical properties at both room temperature and at elevated temperatures remain unchanged. The plasticity and the tensile strength of the specimens were reduced whenever macro-grains were present in the system although the exact correlation between grain size and long-range stability was not established. (TTT)

3125 CAUSE OF CRACKING OBSERVED DURING CRACKING OF SHAFTS. S. S. Gorelik, S. M. Faĭnbron, A. M. Katkova, and L. V. Shelgaeva. Metalloved. i Termichesk. Obrabotka Metal. No. 9, 17-19(1960) Sept. (In Russian)

The effects of deformations on the plastic properties of annealed and forged specimens of steel were studied to establish the effect of columnar structure. Results indicated that steel specimens had a higher tensile strength in the direction parallel to the long axis of the elliptically deformed crystals than in the perpendicular direction. This anisotropy of the plasticity was found to be more marked the lower the temperature and the higher the degree of deformation. This behavior is explained by the differential plasticity of the central crystalline region and by the presence of a rigid intergranular skeleton. This anisotropy is responsible for microscopic cracks. Whenever the elliptical structure is noticed, the material should be withdrawn from any usage involving stamping or punching. (TTT)

3126 PROPERTIES OF TUNGSTEN ALLOYS WITH RHENIUM. E. M. Savitskiĭ, M. A. Tylkina, S. I. Ipatova, and E. E. Pavlova (Inst. of Metallurgy, Academy of Sciences, USSR). Metalloved. i Termichesk. Obrabotka Metal. No. 9, 20-5(1960) Sept. (In Russian)

The W–Re phase diagram was studied in the solid solution region, which ranges from nearly 45 wt. % rhenium at 2850°C (near the melting point) to 32 wt. % rhenium at 1100°C. From x-ray-diffraction data, it was concluded that beyond the 10 wt. % rhenium region, the solid solution undergoes a phase transformation. A very hard σ type compound was formed at 2890°C by a peritectic reaction. The range of solid solutions of tungsten in rhenium is somewhat narrower, from 15 wt. % near the melting point to 12 wt. % at 1100°C. A eutectic mixture was formed between the rhenium-based solid solution and the σ phase, containing 75 wt. % rhenium and having a hardness of 800 kg/mm^2. The microhardness of the σ phase was 2000 kg/mm^2. Introduction of rhenium into tungsten increased the recrystallization temperature, tensile strength, and plasticity of the system. Wires of a tungsten alloy containing 20 wt. % rhenium had a tensile strength of 160 to 190 kg/mm^2 and an elongation of 18 to 20% after annealing. The specific resistivity also increased considerably. These alloys are recommended for use in vacuum tubes as cathode, heater wire, etc. The alloys are also useful as thermocouple wire and as contact material. (TTT)

3127 DIFFUSION LAWS AND THE DISTRIBUTION OF ELEMENTS IN ALLOYS. P. L. Gruzin (Central Scientific Research Inst. of Ferrous Metallurgy, [USSR]). Metalloved. i Termichesk. Obrabotka Metal. No. 10, 5-13(1960) Oct. (In Russian)

Measurements of the integrated radioactivity of successively removed layers of the alloy specimens offer a reliable method for studying the volume and boundary diffusion of metals. Diffusion coefficients in the range of 10^{-13} to 10^{-14} cm^2/sec^{-1} could be determined with ease. Autoradiographic techniques made it possible to perform measurements on very small samples. It was established that in the case of relatively refractory metals, such as Fe, Cr, Co, Ni, Zr, Ta, Mo, and W, the temperature dependence of self-diffusion assumes an exponential character for the region beyond the threshold of recrystallization. The mobility of atoms at a given temperature differs strongly from metal to metal, for example, the values of self-diffusion coefficients of aluminum, iron, and tungsten in the temperature range of 500 to 1000°C differ by 10 orders of magnitude. In the case of ferrous alloys, phase transformations and structural changes complicate the determinations. In view of the importance of the system, the diffusion of carbon in pure iron and in austenite was thoroughly studied. Iron holds strongly the valence electrons of silicon and carbon, which explains why the strongly covalent SiC is not formed in the presence of iron. (TTT)

3128 NATURE OF THE HARDENED STATE OF METALS. G. V. Kurdyumov (Central Scientific Research Inst. of Ferrous Metallurgy, [USSR]). Metalloved. i Termichesk. Obrabotka Metal. No. 10, 22-30(1960) Oct. (In Russian)

Alloys with an equilibrium structure as a result of annealing have a low resistance against plastic deformation; their strength is several hundred times less than could be calculated from the value of their interatomic bonds. They can be strengthened considerably by suitable mechanical or thermal treatment. Autoradiographic measurements of a calcium admixture in titanium, of carbon in zirconium, and of chromium in zirconium showed that such hardening of pure metals and single-phase alloys is connected with the disintegration of the grains and the scattering of the fragments under formation of submicroscopic phases. The degree of hardening caused by plastic deformation of martensitic transformation is determined by the properties of these stable or metastable crystalline phases, although incipient cracks limit the ultimate development of strength. Preparation of crystals free from defects results in very high-strength material, approaching the theoretical value. The chief difficulty is caused by the metastable nature of the system. (TTT)

3129 EFFECT OF THE ELECTROCHEMICAL TREATMENT ON THE MECHANICAL PROPERTIES OF STEELS. N. T. Kudryavtsev and I. I. Moroz. Metalloved. i Termichesk. Obrabotka Metal. No. 10, 36-40(1960). (In Russian)

As a result of the study of the mechanical changes observed after electroplating steel specimens with Zn, Cd, Cu, Cr, Sn, and Pb, it was found that bending strength and other properties decrease, especially in the initial period

of the electroplating. This is due to the fact that the initially deposited thin layer does not offer a strong barrier to the diffusion of hydrogen into the steel which is responsible for the weakening. Cadmium and copper deposited from cyanide baths and tin and lead deposited from acid baths caused less weakening of the base metal than zinc deposited from a cyanide bath. Chromium plating was found to be the most harmful. It is recommended that the cyanide type zinc plating bath be replaced by an electrolyte containing $Zn(BF_4)_2$ or that cadmium coating be used instead. (TTT)

3130 IMPROVEMENTS TO THE PROPERTIES OF URANIUM BY ADDITION OF SMALL QUANTITIES OF OTHER METALS. M. Englander (Centre d'Étude Nucléaire, Saclay, France). Métaux (Corrosion–Inds.) 34, No. 410, 18p.(1959) Oct. (In French). (CEA-1474)

The most economical nuclear fuel used in power reactors that produce energy for industrial purposes is metallic uranium, either in natural form or slightly enriched in the U^{235} isotope. Under optimum working conditions any fuel should produce a minimum of 3000 Mwd/ton, i.e., 72×10^6 kw-hr per ton of natural uranium, while at the same time being maintained at a temperature sufficiently high for it to fulfill its role of heat-source at a minimum of between 350 and 550°C. Polycrystalline aggregates in uranium billets, obtained either by casting under vacuum or by extrusion at high temperature, are made up of coarse grains having broken-up irregular contours and exhibit numerous signs of intergranular deformation (twin crystals, slip-lines) as well as a pronounced substructure. The range of grain diameters extends from a few microns up to a few millimeters, according to the micrographic zones examined. (auth)

3131 SOLUBILITY AND DIFFUSION OF HYDROGEN IN ZIRCONIUM. Mayumi Someno. Nippon Kinzoku Gakkaishi 24, 249-53(1960). (In Japanese and English)

The solubility of hydrogen in zirconium was determined as a function of temperature (range: 500 to 900°C) and pressure (range: 10^{-3} to 30 mm Hg). The diffusion coefficients for hydrogen in α-zirconium (range: 450 to 700°C) and in β-zirconium (range: 870 to 1100°C) were calculated by the diffusion-annealing method, which consisted of annealing the diffusion couples of different hydrogen contents in lead bath and analyzing the hydrogen gradients across the diffusion zone. The calculated diffusion coefficients of hydrogen in α- and β-zirconium are expressed, respectively, as: $D_\alpha = 4.15 \times 10^{-3} \exp(-9470/RT)$ cm²/sec (450 ~ 700°C) and $D_\beta = 7.37 \times 10^{-3} \exp(-8540/RT)$ cm²/sec (870 ~ 1100°C). (auth)

3132 THE STRUCTURE OF MAGNETIC MATERIALS. J. Villain (Centre d'Etudes Nucléaires, Saclay, France). Phys. and Chem. Solids 11, 303-9(1959). (In French). (CEA-1490)

The prediction of the structure of magnetic materials below the critical point is considered. The molecular field approximation is used. Exchange interactions with unlimited range are assumed. The magnetic ions are supposed to form a Bravais lattice. The critical temperature T_c is first calculated without assuming any decomposition of the crystal into sublattices, and the magnetic structure at T_c is given. It is next shown that the essential features of this structure persist below T_c, and the various possible cases are considered. It is possible that no decomposition into sublattices takes place, i.e., the magnetic structure and the nuclear structure have incommensurable periods. A detailed treatment is then given for the body-centered quadratic lattice with interaction between first, second, and third neighbors. (auth)

3133 THERMAL PROPERTIES OF GRAPHITE, MOLYBDENUM AND TANTALUM TO THEIR DESTRUCTION TEMPERATURES. N. S. Rasor and J. D. McClelland (Atomics International, Canoga Park, Calif.). Phys. and Chem. Solids 15, 17-26(1960) Aug. (In English)

Thermal expansion, specific heat, and thermal conductivity were determined from 1000°C to near the destruction temperature of molybdenum (mp 2620°C), tantalum (mp 3000°C), and four types of graphite (sublimes at 3650°C). The thermal-expansion data for the materials investigated showed no grossly unusual features except those due to impurity evolution. The specific heat of the metals, particularly that of molybdenum, appreciably exceeded the Dulong-Petit value. However, their thermal conductivities followed closely the Lorenz (Wiedemann-Franz) relation for free electrons. At intermediate temperatures (1000 to 2800°C) the thermal conductivity and specific heat of graphite showed no unusual features. At higher temperatures, however, large and rapid increases in specific heat and thermal resistivity appeared, which were consistent with the occurrence of thermally produced lattice defects, presumably vacant lattice sites. A defect concentration of about 0.5 at. % at the sublimation temperature, and a formation energy in the vicinity of 7.7 ev, were indicated. (auth)

3134 ELECTRICAL RESISTIVITY OF THE HEAVY RARE-EARTH METALS. R. V. Colvin, Sam Legvold, and F. H. Spedding (Ames Lab., Ames, Iowa). Phys. Rev. 120, 741-5(1960) Nov. 1. (IS-134)

The electrical resistivities of polycrystalline Gd, Tb, Dy, Ho, Er, Tm, and Lu were measured between 1.3°K and room temperature. The slope of the resistivity curve for gadolinium changes near the curie point. The curve for terbium is very much like that for gadolinium, but there is some evidence that two ordering temperatures exist for this metal. Dysprosium, holmium, and thulium all show peaks in resistivity near their Néel points, while erbium shows only a change in slope at its Néel point. The change from ferromagnetism to antiferromagnetism in dyprosium is seen as a sharp rise in the resistivity. (auth)

3135 PARAMAGNETIC BEHAVIOR OF POLYCRYSTALLINE SAMARIUM FROM 300°K to 1400°K. Sigurds Arajs (U. S. Steel Corp., Research Center, Monroeville, Penna.). Phys. Rev. 120, 756-9(1960) Nov. 1.

The paramagnetic susceptibility of polycrystalline samarium metal was measured as a function of temperature between 300 and 1400°K. The high-temperature phase transformations did not produce noticeable discontinuities in the magnetic susceptibility, indicating that the interactions between the samarium ions are small at these temperatures. The experimental results are compared with the Van Vleck theory of paramagnetism. It appears that the energy levels of Sm^{2+} in metallic samarium differ more from those predicted by the Russell-Saunders coupling than was realized. Collective magnetic behaviors resulting from the interactions between the samarium ions are briefly discussed in the light of some recent low-temperature investigations. (auth)

3136 PROPERTIES OF GRAPHITE. PART II. THERMAL AND ELECTRONIC PROPERTIES. L. C. F. Blackman (Imperial Coll. of Science and Tech., London). Research (London) 13, 441-8(1960) Nov.

The thermal and electronic properties of near-ideal and defective graphite are discussed in terms of the fundamental anisotropic crystal structure. The specific heat of graphite was found to vary as T^2 until very low temperatures were reached; this was in constrast to the classical prediction that it should vary as T^3. The room temperature

thermal conductivity of highly crystalline natural and synthetic graphite exceeds that of the best metal conductors. It was found to be the lattice vibrations that determine this thermal conductivity. The variation of thermal conductivity with temperature was determined. The thermal expansion of well-ordered graphite was found to be extremely anisotropic by careful x-ray diffraction measurements. A brief account of the theoretical calculations made concerning the band structure of graphite is presented. The electrical resistivity of natural and synthetic polycrystalline graphite usually lies in the range of 8 to 12×10^{-4} ohm cm. The anisotropy of the electrical resistivity of ideal graphite exceeds that of any other property. The diamagnetic susceptibility of graphite in the direction perpendicular to the layer planes was found to be anomalously high. (M.C.G.)

3137 AN ELECTRON DIFFRACTION STUDY OF THE TUNGSTEN CARBIDE WC. L. N. Butorina (Gorkii State Univ., [USSR]). Soviet Phys.-Cryst. 5, 216-20(1960) Sept.-Oct.

The crystal structure of WC was studied by the method of sections of F^2 and F series based on electron-diffraction patterns with electron scattering of kinematic and intermediate character. On the electron diffraction photographs, 46 reflections were measured, corresponding to the primitive hexagonal lattice. Analysis of the results showed sharp fluctuations in the relative intensities of the first, strongest reflections. On the basis of the arrangement of the atoms, the theoretical structure amplitudes were calculated. (M.C.G.)

3138 PRECIPITATION OF THE CARBIDE PHASE IN CARBON STEELS. A. I. Gardin (All-Union Scientific Research Inst. for Instrumentation, [USSR]). Zavodskaya Lab. 26, 1088-90(1960). (In Russian)

Investigation of the carbide phase that precipitated out in carbon steels during a low-temperature heat treatment, using N. M. Popova's electron-diffraction method (Zavodskaya Lab. 11, 10(1945)), showed that a disturbingly high background confuses the values. Interferometric studies showed that during annealing below 400°C a surface layer containing impurities is formed which makes it impossible to study the carbide phase formed during the decomposition of the austenite. In order to eliminate this difficulty, the carbide phase was precipitated during electrolysis of the sample in a nonaqueous electrolyte containing 5% $FeCl_3$ in methyl alcohol and citric acid, using a current density of 0.01 to 0.02 amp/cm^2 at −8°C. Electron-diffraction studies indicated that the deposit formed was free from impurities. It was established that in annealing the eutectoid steel at 350°C, two phases are obtained: one with a close-packed hexagonal lattice and another having a structure similar to that of cementite, although with different coordinates for the iron and carbon atoms. (TTT)

3139 A METHOD FOR THE METALLOGRAPHIC DETERMINATION OF MOLYBDENUM. S. B. Maslenkov and Yu. I. Demkin (Bardin Central Scientific Research Inst. of Ferrous Metallurgy, [USSR]). Zavodskaya Lab. 26, 1093 (1960). (In Russian)

A new process for studying the microstructure of molybdenum was developed which involves electropolishing the mechanically polished specimens in an electrolyte containing 95 ml of H_2SO_4 and 5 ml of methyl alcohol. Stainless steel was used as the cathode and the voltage of the cell was kept at 14 volts. After rinsing, the specimens were etched with a solution of 10g KOH and 10g $K_3Fe(CN)_6$ in 100 ml of water for a short period of time. By this method, the microstructure of cast and wrought specimens and of those prepared by powder metallurgy were brought out in a time period of only 5 to 10 min. (TTT)

3140 THERMOELECTRIC GENERATOR MATERIALS. R. C. Miller and R. W. Ure, Jr. (Westinghouse Research Labs., Pittsburgh). Paper No. 1273-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 19p.

Some of the best materials known at present which are suitable for use in thermoelectric generators operating at 30 to 1030°C are Bi_2Te_3 and its alloys, PbTe, the III-V compounds, MnTe, GeTe, and CeS. The properties of these materials that are important for their use in thermoelectric generators are discussed. (auth)

3141 PHASE EQUILIBRIA AND PROPERTIES OF YTTRIUM–TITANIUM ALLOYS. D. W. Bare and O. N. Carlson (Ames Lab., Ames, Iowa). Preprint No. 178. Presented at the Forty-Second Annual Convention of the American Society for Metals, Philadelphia, October 17-21, 1960. Novelty, Ohio, Society Headquarters, Metals Park. 11p. (ISC-1179).

The Y–Ti system was investigated by microscopic, electrical resistivity, thermal, and x-ray methods. A phase diagram for the system is proposed. The system exhibited simple eutectic behavior with limited primary solid solubility. The eutectic occurred at 13 wt. % titanium and at a temperature of 1330°C (2426°F). The maximum terminal solid solubility at either end of the system was less than 1 wt. %. Data on the hardness, corrosion, and oxidation properties are given for several alloys. (auth)

3142 COLUMBIUM-CARBON SYSTEM. Rodney P. Elliott (Illinois Inst. of Tech., Armour Research Foundation, Chicago). Preprint No. 179. Presented at the Forty-Second Annual Convention of the American Society for Metals, Philadelphia, October 17-21, 1960. Novelty, Ohio, Society Headquarters, Metals Park. 16p.

The Nb–C system was determined by x-ray and metallographic examination of sintered and arc-cast alloys. Two carbides exist: hexagonal Nb_2C with a limited range of homogeneity and cubic NbC with a solubility range from 8.25 to 10.25 wt. % carbon. Dilute alloys froze by eutectic reaction at 2230°C. The solubility of carbon in niobium was 0.80 at the eutectic temperature, but decreased rapidly with temperature. Metallographic evidence indicated a peritectic reaction between melt, Nb_2C, and NbC. Alloys richer in carbon than NbC froze by eutectic reaction. (auth)

3143 LIQUID-METAL FUEL CONSTITUTION. I. THE SOLUBILITY OF URANIUM IN BISMUTH. Donald G. Schweitzer and John R. Weeks (Brookhaven National Lab., Upton, N. Y.). Preprint No. 195. Presented at the Forty-Second Annual Convention of the American Society for Metals, Philadelphia, October 17-21, 1960. Novelty, Ohio, Society Headquarters, Metals Park. 8p. (BNL-4363).

High-vacuum, high-temperature equipment for rapid, accurate determinations of liquid-metal solution compositions is described. The solubility of uranium in bismuth was redetermined over the temperature range 300 to 725°C with improved precision and temperature calibration. Anomalous solubility effects in uranium–bismuth–graphite systems which could affect the operation of reactors containing graphite are described. (auth)

3144 IMPROVED MAGNESIUM ALLOYS. Geoffrey Charles Edward Olds (to British Thomson-Houston Co., Ltd.). British Patent 851,871. Oct. 19, 1960.

The creep strength of magnesium alloyed with zirconium and zirconium-zinc at 500°C may be improved for use in reactor-fuel-element canning by incorporating a small amount of manganese in the alloys. The proportions by weight should be: 0.3 to 1.0% Zr; 0.05 to 0.5% Mn; 0 to 2.0% Zn; and the balance, Mg. Some creep and strength data are given. (D.L.C.)

3145 ALLOY MEMBERS SUITABLE FOR USE AS NUCLEAR FUEL ELEMENTS AND PROCESS FOR MAKING THE SAME. (To U. S. Atomic Energy Commission). British Patent 854,096. Nov. 16, 1960.

A uranium alloy exhibiting high resistance to corrosion by high-temperature water and steam and suitable for use as a fuel alloy in pressurized water and other types of reactors can be fabricated. The alloy consists of 3 to 25% niobium, 1 to 30% zirconium, and the balance uranium, the total weight of niobium and zirconium not exceeding 40%. The alloy should be in the γ phase and clad with a zirconium-base alloy containing 0.1 to 2.5% tin and 0.1 to 2% of at least one of the elements iron, niobium, or chromium, and having a thickness $\geq$0.009 in. A method for producing and fabricating the fuel alloy is presented. A clad fuel alloy made in this way gave only a 1 to 2 vol. % increase at 0.45% burn-up and 385°C in a reactor, as compared with 8 to 10 vol. % increases for U–Nb alloys. Out-of-pile corrosion tests showed that this alloy has superior resistance compared with U–Nb alloys. (D.L.C.)

Radiation Effects

3146 (AERE-M-725) THE OXIDATION OF URANIUM DIOXIDE BY WATER VAPOUR UNDER REACTOR IRRADIATION. B. R. Harder and R. G. Sowden. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Aug. 1960. 17p. BIS.

Declassified version of AERE-M-561.

Semiquantitative experiments were carried out to investigate the stability of UO_2 in contact with water vapor under irradiation. The data, although limited to temperatures of 80°C and water-vapor pressures below 1 atm., indicate that oxidation is brought about mainly by oxygen produced during radiolytic decomposition of the water vapor. Oxidation rates may therefore be calculated from a knowledge of G_{H_2}; an estimate based on extremely pessimistic assumptions suggests that the oxidation rate of pellets in defected cans in a steam-cooled reactor will be low. Subsidiary data provide evidence for the oxidation of U_3O_8 to UO_3 in the presence of irradiated water vapor and of oxygen. Data obtained in the presence of liquid water separated from the fissile powder are ambiguous; the possibility of an enhancement of water decomposition by a chemisorption effect is suggested. (auth)

3147 (ANL-6010) SUMMARY REPORT ON IRRADIATION OF PROTOTYPE EBR-II FUEL ELEMENTS. J. H. Monaweck and E. S. Sowa. Argonne National Lab., Ill. Sept. 1960. 32p. Contract W-31-109-eng-38. OTS.

The series of irradiations performed in the CP-5, MTR, and ETR on promising prototype EBR-II fuel elements is summarized. Type 304-clad uranium-zirconium and uranium-fissium alloy fuel pins were exposed to conditions approaching the anticipated parent-core environment. Special facilities were designed to promote maximum fuel centerline temperatures ranging from 700 to 1200°F and fuel atom burnups from 0.4 to 1.56%. The exposure history and the effects of irradiation are described and illustrated photographically. These include dimensional and density changes, fission-gas build-up, and fission-product contamination of the sodium thermal bond as a function of fuel burnup and operating temperature. The lesser physical changes evidenced in the stainless-steel-clad uranium-fissium alloy support its superiority over the zirconium-uranium alloy and its ultimate selection for the initial core loading of the EBR-II. (auth)

3148 (HW-64168) BURST TESTING OF IRRADIATED ZIRCALOY TUBING. V. E. Kahle. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Mar. 4, 1960. 11p. Contract AT(45-1)-1350. OTS.

Burst tests were performed on 65% cold-worked Zircaloy-2 tubing which was operated under intense neutron radiation and water temperatures up to 250°C. The irradiated tube sections failed at pressures 10 to 15% above those for the unirradiated control pieces. (C.J.G.)

3149 (KAPL-2000-11(p.III.12-III.30)) NONDESTRUCTIVE DETERMINATION OF FISSION DISTRIBUTION IN IRRADIATED FUELS. D. G. Miller. Knolls Atomic Power Lab., Schenectady, N. Y.

A study is presented of the feasibility of a nondestructive fission-distribution determination based on the measurement of a specific long-lived fission-product isotope in irradiated fuel. Such a determination can be performed, with limitations, by utilizing the 2.19-Mev photopeak associated with 285-day Ce^{144}–Pr^{144}. After a 3-month cooling period, this photopeak is completely resolvable in the gross fission-product spectrum. For cooling periods of less than 3 months, the contribution of 13-day Ba^{140}–La^{140} in the 2.19-Mev photopeak area is significant. Agreement between the nondestructive method and the destructive analysis of a short-cooled element used in this work is demonstrated to be within ±1.8%. The use of the 0.66-Mev photopeak of Cs^{137} for the nondestructive determination of fission distribution in elements cooled for 2 years is also demonstrated. (W.L.H.)

3150 (TID-6790) ANNUAL PROGRESS REPORT (1960). Rohn Truell. Brown Univ., Providence. 6p. Contract AT(30-1)-1772. OTS.

Results obtained during the report period on study of radiation effects in solids by ultrasonic methods are reported. Activities reported include in-reactor measurements of attenuation and velocity during irradiation of quartz and aluminum. Quartz was also studied before and after irradiation and during annealing after irradiation. The attenuation change in NaCl at room temperature and at −195°C under γ irradiation was studied along with the dislocation damping changes in alkali halides during deformation and during recovery following deformation. (For preceding period see AECU-4637.) (J.R.D.)

3151 (TID-7588) USAEC CONFERENCE ON THE STATUS OF RADIATION EFFECTS RESEARCH ON STRUCTURAL MATERIALS AND THE IMPLICATIONS TO REACTOR DESIGN, HELD AT CHICAGO, ILLINOIS, OCTOBER 15-16, 1959. Atomic Energy Commission, Washington, D. C. Oct. 1960. 312p. OTS.

The papers contained were presented during the Oct. 1959 meeting of the AEC Welding Forum. During the June 21 meeting, means for making research efforts more productive of data suitable for design purposes were discussed. Separate abstracts have been prepared for twelve of the fourteen papers. (W.D.M.)

3152 (TID-7588(p.56-90)) NEUTRON RADIATION EMBRITTLEMENT AT 500°F AND 650°F OF REACTOR PRESSURE VESSEL STEELS. J. V. Alger and L. M.

Skupien. Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh. (WAPD-T-913).

The effects of neutrons on the impact and tensile properties of ASTM-A302B, SA-336, and HY-65 high-strength pressure vessel steels, and weld metal deposited with types E-9016 and E-10016 electrodes were studied. Irradiation was carried out at 500°F in dry air to an integrated flux of 2×10^{18} to 3×10^{18} nvt. Materials irradiated at 500°F were appreciably embrittled. (W.D.M.)

3153 (TID-7588(p.91-127)) RADIATION EFFECTS IN FERRITIC STEELS. R. G. Berggren. Oak Ridge National Lab., Tenn.

Studies on the radiation effects in steels consisting of tensile, notch-impact, and hardness tests on a variety of irradiated steels are described. Irradiations were conducted in beam holes of the Materials Testing Reactor, Low Intensity Test Reactor, and Oak Ridge Research Reactor. Results are subdivided into effects of irradiation at temperatures between 100 and 350°F, temperatures above 400°F, and postirradiation annealing. (W.D.M.)

3154 (TID-7588(p.128-39)) STUDIES AT HARWELL ON NEUTRON IRRADIATION EFFECTS IN STEELS. D. R. Harries. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

Some preliminary results are given from a program to assess the effects of neutron irradiation on the notched-bar properties of specimens machined from welded steel plates as a function of irradiation-temperature-integrated neutron dose, flux spectrum, and type and heat-treatment of steel. Some attempts were made to determine the mechanism of radiation embrittlement in steels. (W.D.M.)

3155 (TID-7588(p.177-88)) EFFECT OF IRRADIATION ON MECHANICAL PROPERTIES OF MATERIALS FOR REACTOR PRESSURE VESSELS. L. P. Trudeau. Atomic Energy of Canada Ltd., Chalk River, Ont.

Results obtained to date in a study of the neutron irradiation behavior of pressure vessel steels of present and possible future interest are summarized. Irradiations were carried out in the Canadian National Research Experimental Reactor at 120 to 160°F. Integrated fluxes are reported for neutrons with energies above 500 ev. (W.D.M.)

3156 (TID-7588(p.189-204)) PROGRAMS ON THE EFFECTS OF NEUTRON IRRADIATION UPON THE MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS. E. E. Baldwin. Knolls Atomic Power Lab., Schenectady, N. Y.

Several irradiation effects programs on structural materials that have been completed or are in progress are described in an attempt to demonstrate the importance of obtaining information on radiation effects on structural materials, and some ways in which these effects can be determined. Materials considered included ASTM A-302B, ASTM A-201, Inconel, and type 347 stainless steel. (W.D.M.)

3157 (TID-7588(p.205-17)) TENSILE AND STRESS-RUPTURE PROPERTIES OF IRRADIATED STAINLESS STEELS AND INCONEL. R. G. Berggren, W. E. Brundage, W. W. Davis, N. E. Hinkle, and J. C. Zukas. Oak Ridge National Lab., Tenn.

Limited studies were conducted at ORNL on the mechanical property changes induced in austenitic and ferritic stainless steels by exposure to high-energy neutrons. Typical results are presented to illustrate the type of neutron-induced changes that were observed. Studies are in progress on the stress-rupture properties of Inconel during irradiation at 1500°F in air, and some data on these properties are presently available. (auth)

3158 (TID-7588(p.218-29)) PRACTICAL ASPECTS OF REACTOR PRESSURE VESSEL DESIGN. D. K. Davies. Babcock and Wilcox Co. [Atomic Energy Div., Lynchburg, Va.].

A typical reactor pressure vessel is analyzed in an attempt to isolate various problem areas and determine what can be done about them. Primary coolant nozzle openings and discontinuities are considered. Raw material processing for a radiation-resistant finished product is discussed. (W.D.M.)

3159 (TID-7588(p.237-44)) IMPLICATIONS OF RADIATION EFFECTS TO REACTOR PRESSURE VESSEL DESIGN. W. E. Cooper. Knolls Atomic Power Lab., Schenectady, N. Y.

The ultimate goal with respect to the effects of radiation on pressure vessel design must be the quantitative evaluation of the irradiated material properties with respect to the structural reliability of the design. Potential sources of vessel failure and the pertinent material properties are outlined. The sources are excessive plastic deformation; fatigue; corrosion fatigue; stress corrosion; metal wastage; brittle fracture; excessive elastic deformation; buckling; and rupture. Present and alternate industrial structural evaluation practices are discussed. It is concluded that even though alternate procedures represent a significant advance over present practice, these procedures are not yet sufficiently complete and explicit to justify general application, particularly with respect to radiation effects. The question "How does radiation affect the ability of a pressure vessel to withstand each of the potential sources of failure?" is discussed. Attempts are made to answer this question in the hope that further discussion will result in more conclusive answers. The major areas requiring immediate attention are concluded to be fatigue and brittle fracture. The influence of radiation upon the rupture characteristics of a pressure vessel is also stated to be an area of concern. (auth)

3160 (VDIT-21) RADIATION EFFECTS IN THERMOCOUPLES—BIBLIOGRAPHY. (Stralningseffekter i Termoelement—Bibliografi). W. Uhlmann. Aktiebolaget Atomenergi, Stockholm. Sept. 14, 1960. 5p.

A bibliography of 13 selected references to report and published literature on radiation effects in thermocouples is presented. (J.R.D.)

3161 (WAPD-BT-20(p.1-22)) THE EFFECTS OF IRRADIATION ON BeO + UO_2, ThO_2 + UO_2, AND ZrO_2 + CaO + UO_2. W. Yeniscavich and M. L. Bleiberg. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

Three constitutionally different ceramic fuels sealed in Zircaloy-2 were exposed to reactor irradiation in a hot-water loop to burn-ups of about 10^{21} fissions/cc. It was found that dispersion fuels of 28 wt.% UO_2 in a BeO matrix were dimensionally unstable owing to the formation and subsequent agglomeration of large fission-gas bubbles and also because of the destruction of the BeO crystal lattice by fission fragments. Two-phase ceramic fuels consisting of cubic stabilized ZrO_2 and $CaZrO_3$ were only slightly affected by irradiation but exhibited gross dimensional instability when exposed to simultaneous irradiation and corrosion; solid solutions of 14 wt.% UO_2 in ThO_2 were found to be essentially unaffected by the irradiation exposure. (auth)

3162 (SCL-T-336) ON THE KINETIC CHANGES IN MARTENSITE TRANSFORMATION UNDER THE INFLUENCE OF IRRADIATION. (Ob Izmenenii Kinetiki Martensitnogo Prevrashchenia pod Vliyaniem Obluchenia). A. I.

Zakharov and O. P. Maksimova. Translated by Marcel I. Weinreich (Sandia Corp.) from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk No. 7, 3-9(1958). 15p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 2211.

3163 CHANGE IN THE CAPACITANCE OF AN AIR-DIELECTRIC CAPACITOR DURING IRRADIATION. V. P. Sokolov. Atomnaya Energ. 9, 142-3(1960) Aug. (In Russian)

Variations in air-condenser capacitance under irradiation were studied in a plain air condenser with infinite plates. The capacitance of the condenser is changed by an induction effect on the plates equivalent to a variation of the dielectric penetrability of the medium. Qualitative capacitance variations at small frequencies were evaluated by determining the distribution of potential in the air spaces for a number of configurations, neglecting diffusion and the effects of self-fields on ion motion. The radioinduced variations in condenser capacitance also depend on the plate material. A geometric anisotropy can take place with directed γ beams, depending on the parallel or perpendicular incidence of the beam. (R.V.J.)

3164 EFFECTS OF γ RADIATION ON DIELECTRIC PROPERTIES OF CERTAIN ELECTRIC INSULATING MATERIALS. II. PHENOLFORMALDEHYDE PLASTICS. K. A. Vodop'yanov, B. I. Vorozhtsov, and G. I. Potakhova (Siberian Inst. of Physics and Tech., Tomsk State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 133-7(1960). (In Russian)

The dielectric penetrability, dielectric loss, and electrical stability of various phenol-formaldehyde plastics were studied under various conditions before and after exposure to γ radiation of 30,000 to 100,000 r at 500 to 530 r/m. It was found that at low frequencies and high temperature (60°C) γ radiation induces changes in dielectric loss. The effects diminish with an increase in temperature. The studies show that γ radiation does not alter the electrical stability or dielectric penetrability of the material. (R.V.J.)

3165 RADIATION INFLUENCE ON tg δ IN CERAMICS. I. S. Filatov (Siberian Inst. of Physics and Tech., Tomsk State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 239-40(1960). (In Russian)

Radiation effects on tg δ in B-1 ceramics (91.6% talcum, 5.2% kaolin, and 3.2% boracite) were studied; tg δ dependence on temperature, frequency, and field intensity before and after irradiation was determined. After irradiation with 4.8×10^4 r/hr at 20 to 700°C, tg δ did not vary in either strong or weak fields. After irradiation with 1.06×10^6 r, tg δ was reduced two-fold. Irradiation with 2.12×10^7 r resulted in a complete disappearance of the relaxation maximum and an increase in conductivity losses. (R.V.J.)

3166 GAMMA RADIATION EFFECTS ON DIELECTRIC PROPERTIES OF CERTAIN ELECTRO-INSULATING MATERIALS. III. LACQUERS. K. A. Vodop'yanov, B. I. Vorozhtsov, and T. G. Mikhallova (Siberian Inst. of Physics and Tech., Tomsk State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 4, 152-5(1960). (In Russian)

Dielectric penetrability and dielectric losses of lacquers exhibited no sensitivity to irradiation at +20, +60, −60°C or under conditions of tropical humidity. Experiments with various lacquers confirmed previous postulations on strong resistance to radiation. (R.V.J.)

3167 GAMMA RADIATION EFFECTS ON DIELECTRIC PROPERTIES OF CERTAIN ELECTRO-INSULATING MATERIALS. IV. POLYETHYLENE. K. A. Vodop'yanov, B. I. Vorozhtsov, and N. I. Ol'shanskaya (Siberian Inst. of Physics and Tech., Tomsk State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 4, 156-9(1960). (In Russian)

Irradiation of polyethylene with up to 10 r under normal conditions and at +70°C induced no structural changes. Irradiation at −70°C slightly improved the tg δ and conductivity. Under tropical conditions the tg δ at low frequencies diminishes and ρ_v increases. (R.V.J.)

3168 EFFECT OF RADIATIONS ON METALS. Frederick Seitz (Univ. of Illinois, Urbana). J. chim. phys. 57, 677(1960) Sept. (In French)

A survey is made of the experimental and theoretical studies on the effects of radiations on metals. The most significant studies were made on the noble metals and concern the modifications of the electrical resistance, dimensional changes, and stored energy. Auxiliary experiments include the study of the effects of thermal treatment on the radioinduced faults. The experimental studies were accompanied by calculation of the electric resistivity, dimensional changes, and stored energy associated with a "hole–interstitial atom" pair. (J.S.R.)

3169 ATOMIC PROGRESS. NEUTRON IRRADIATION DAMAGE. [PART] II. Metal Ind. (London) 96, 131-2(1960) Feb. 12.

The physical processes leading to irradiation damage were discussed previously, but no reference was made to the effects of this damage on the mechanical properties of nonfissile materials. This discussion is concerned with the shape of the stress-strain curve, elastic constants, hardening, creep, and ductile-brittle transmission of irradiated materials. Compared with unirradiated specimens the stress-strain curves for irradiated materials show more sharply defined yield points at normal testing speeds. Irradiation with fast neutrons hardens most metals and this can be detected in both single crystals and in polycrystalline samples. Theoretical assessments indicate that either increases or decreases in creep rate are possible. The result depends on the relative effectiveness of point defects produced in impeding the movement of dislocations and the thermal and displacement spikes which may provide sufficient energy for local displacements to occur. Irradiation may cause further embrittlement of those metals which normally show a tendency toward brittle failure. (B.O.G.)

3170 OBSERVATIONS OF THE EMISSION OF LIGHT ON DISSOLUTION OF IRRADIATED SOLIDS IN CERTAIN LIQUIDS. Torbjörn Westermark and Björn Grapengiesser (Royal Inst. of Tech., Stockholm). Nature 188, 395-6(1960) Oct. 29.

The problem of measuring the stored radiomimetic energy in irradiated solids was approached by dissolution in liquids typical for dosimetry by radiochemical techniques and partly by attempts to excite, during dissolution, liquid scintillators. Some results of the latter type are summarized. Most of the experiments were concerned with fine-grained NaCl which was given doses of 200 Mrads of Co^{60} γ rays and 2-Mev electrons from a Van de Graaff machine. Similar experiments were conducted using $ThCl_4$, LiF, KI, glucose, saccharose, and alginic acid in water aqueous solutions, organic solvents, and organic solutions. The results indicate that the phenomenon of stored energy has to be carefully examined, at least for dry solids, before irradiation preservation of foods can be adopted on a large scale. (B.O.G.)

3171 SURFACE HETEROGENEITY IN IRRADIATED SOLIDS. D. A. Young (Brookhaven National Lab., Upton, N. Y.). Phys. and Chem. Solids 15, 119-26(1960) Aug. (In English)

Experiments on the physical adsorption of krypton on unirradiated and neutron-irradiated alumina were performed and analyzed in terms of localized adsorption without marked lateral interaction on surfaces of varying heterogeneity. This interpretation was supported by the shape of the isotherm on unirradiated material and the dependence on coverage of the differential molar entropy of the adsorbed phase. The nature of the surface heterogeneities introduced by irradiation is discussed speculatively. (auth)

3172 COLORATION OF PURE AND DOPED CALCIUM FLUORIDE CRYSTALS AT 20°C AND −190°C. W. J. Scouler and A. Smakula (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 120, 1154-61(1960) Nov. 15.

Coloration of pure CaF_2 crystals with 2.5 Mev electrons at room temperature results in bands at 580, 400, 335, and 225 mμ. In YF_3-doped crystals the bands are in the same spectral positions as in pure crystals. They are, however, enhanced and their intensity ratios are significantly changed, the 400-mμ band being predominant. NaF-doped crystals show an even more drastic change. Coloration at room temperature produces bands at 605, 385, and 330 mμ and is deeper than in either pure or YF_3-doped crystals. Since the 400-mμ band is strongly enhanced by YF_3 addition, which forms F^- interstitials, it is correlated to neutral fluorine atoms in interstitial positions. Similarly the 605-mμ band in crystals doped with NaF, which creates F^- vacancies, is correlated to electrons trapped in F^- ion vacancies (F centers). The enhancement of the 385-mμ band by NaF is explained by the reduction of the activation energy required for formation of interstitials and vacancies. Of several possible correlations the 330-mμ band is probably connected with a hole trapped in a Ca^{2+} vacancy and that at 225 mμ with an electron trapped by a Ca^{2+} interstitial. The bands at 440 and 200 mμ that appear in NaF-doped crystals only must be connected with Na ions. Coloration at −190°C produces strong changes in the absorption spectrum. In pure and YF_3-doped crystals, bands appear at 550, 320, and 270 mμ; whereas, in NaF-doped crystals, bands are formed at 440, 390, 315, and 200 mμ in addition to the 550-mμ band. The primary process of coloration at low temperature cannot differ from that at room temperature, but the secondary processes are strongly influenced by temperature. (auth)

3173 COLOR CENTERS IN ALKALINE EARTH FLUORIDES. D. Messner and A. Smakula (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 120, 1162-6(1960) Nov. 15.

Single crystals of CaF_2, SrF_2, and BaF_2 were colored by x rays (150 kv) and high-energy electrons (2.5 Mev). Five color-center bands in CaF_2 and SrF_2 and nine in BaF_2 were observed in the spectral region between 0.175 and 0.8 μ. At room temperature the bands in CaF_2 are well resolved; whereas, those in SrF_2 and BaF_2 overlap. At −190 and −255°C, the bands sharpen but generally do not shift, except the 580-mμ band in CaF_2, which shifts toward longer wavelengths. Photochemical bleaching of the strongest band shows a certain influence on the others. Three bands could be correlated to the Mollwo relation with the exponent 3.85. A possible correlation of the absorption bands to certain models is discussed. (auth)

3174 RADIOACTIVE PREPARATION OF DEFECTS IN SOLIDS. John Lambe (Ford Motor Co., Dearborn, Mich.). Phys. Rev. 120, 1208-11(1960) Nov. 15.

An experimental study was made of the use of radioactive materials in preparing defects in solids. Paramagnetic resonance was used to study such defects. The systems studied utilized tritium and Kr^{85}. Solid tritium was studied at 4.2°K. It was found that atomic tritium was formed and showed a characteristic hyperfine splitting of 543 gauss. The Kr^{85} was also studied at 4.2°K. This should yield atomic rubidium, but no paramagnetic resonance characteristic of this atom was found. (auth)

3175 DYNAMICS OF RADIATION DAMAGE. J. B. Gibson, A. N. Goland, M. Milgram, and G. H. Vineyard (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 1229-53(1960) Nov. 15. (BNL-4871)

Radiation damage events at low and moderate energies (up to 400 ev) were studied by machine calculations in a model representing copper. Orbits of knock-on atoms were found and the resulting damaged configurations observed to consist of interstitials and vacancies. Thresholds for producing permanently displaced atoms (i.e., interstitials) were about 25 ev in the (100) direction, 25 to 30 ev in the (110) direction, and around 85 ev in the (111) direction. Collision chains in the (100) and (110) directions were prominent. At low energies the chains focused, at higher energies they defocused. Above threshold, the chains transported matter, as well as energy, and produced an interstitial at a distance. The range of (110) chains was studied in detail. Localized vibrational modes associated with interstitials, agitations qualitatively like thermal spikes, ring annealing processes, and a higher energy process somewhat like a displacement spike were observed. Replacements were found to be very numerous. The configurations of various static defects were also studied in this model. The interstitial was found to reside in a "split" configuration, sharing a lattice site with another atom. The crowdion was found not to be stable, and Frenkel pairs were stable only beyond minimum separations, which were found to be very much dependent on orientation. (auth)

3176 CONCERNING THE HOLE-CAPTURE CROSS SECTION OF DEFECTS PRODUCED IN GERMANIUM BY γ-IRRADIATION. R. F. Konopleva, S. M. Ryvkin, and I. D. Yaroshetskiĭ (Leningrad Inst. of Physics and Tech.). Soviet Phys.-Solid State 2, 533-5(1960) Oct.

In reported investigations of the structure of defects appearing in γ- and neutron-irradiated n-type germanium, the observed values of the hole-capture cross sections for the radiation centers q_p differ by an order of magnitude. It is indicated that one reason for the observed difference is associated with the fact that it was assumed that for each defect produced by γ rays there corresponds two acceptor levels in the forbidden band. Vitovskii et al., showed that in reality there are four acceptor levels associated with each defect from γ rays. The results of an experimental investigation of the dependence of lifetime on γ irradiations and calculations of the hole-capture cross section are tabulated. These data give an average value of the hole-capture cross section for the γ-ray produced defects of $q_p = 3.8 \times 10^{-15}$ cm^2 which agrees well with the value of 3×10^{-15} cm^2 for neutrons obtained by Curtis et al., and with the values of 1.6×10^{-15} cm^2 and 1.5×10^{-15} cm^2 obtained by Konopleva et al., and Vavilov et al., respectively. (B.O.G.)

3177 SPONTANEOUS GENERATION OF COLOR CENTERS IN IRRADIATED ALKALI HALIDE CRYSTALS AFTER ANNEALING. A. A. Vorob'ev and B. V. Budylin. Soviet Phys.-Solid State 2, 615-16(1960) Oct.

Spontaneous creation of color centers was observed in crystals of NaCl, KCl, KBr, and KI irradiated in a reactor and thereafter annealed at temperatures from 200 to 450°C until transparency to visible light was restored. The crea-

tion of the color centers is caused by interaction between radioactive sources created within the crystal due to irradiation in the reactor and the crystal material. A method of bulk irradiation of the above-mentioned materials by nonpenetrating types of radiation is proposed. (auth)

3178 THE EFFECT OF X-RAY IRRADIATION ON THE ANOMALOUS PROPERTIES OF ROCHELLE SALT. K. N. Karmen (Shakhty State Pedagogical Inst., [USSR]). Soviet Phys.-Solid State 2, 629-32(1960) Oct.

The application of a constant electric field for a long period was found to considerably alter the anomalous properties of Rochelle salt. The results suggested that apart from the direct action of the regions of spontaneous polarization an electric field applied to Rochelle salt produces displacements of the lattice defects which tend to impede the process of reorientation of the spontaneous polarization regions. This effect of the lattice defects is responsible for the slow changes of the hysteresis which were observed after several hours from the moment of application or reversal of the sign of a d-c bias field. The correctness of this hypothesis was checked by the application of an electric field for long periods to the x-irradiated salts. Considering the results from the x-ray effects on the dielectric and the piezoelectric polarization properties of Rochelle salt, the analogy between the two is seen. Although precise information on the nature of the lattice defects is not available, the possibility of displacement of the defects can be regarded proven. The proof lies in the closed cycle of changes of the states produced by application of fields to the same irradiated sample. (B.O.G.)

3179 APPEARANCE OF THE EMF IN LEAD SULFIDE FILMS ON BEING IRRADIATED BY SLOW ELECTRONS. O. M. Artamonov and L. P. Strakhov (Leningrad State Univ.). Soviet Phys.-Solid State 2, 715(1960) Oct.

Photoelectromotive forces were previously observed in polycrystalline films of lead sulfide obtained by vaporization in vacuum on glass. This photo-emf depended on the angle of incidence of the light beam and changed sign on both sides of a certain fixed direction, which coincided approximately with the direction of incidence of the molecular beam in the formation of the layer. When the PbS films were bombarded with slow electrons (3 to 300 ev), electromotive forces arose, the magnitude and sign of which depended on both the direction and the energy of the incident electrons. The magnitude of the emf that appears depends on the intensity and angle of incidence of the electron beam, but does not ordinarily exceed a value of a few hundredths of a volt. On varying the electron energy, the magnitude and even the sign of the emf that arises is seen to change. If light and electrons bombard a film simultaneously, the sum total effect approximately corresponds to algebraic addition of the emf arising with the separate action of the light and electrons. (B.O.G.)

3180 THE INFLUENCE OF HIGH ENERGY RADIATION ON COTTON. PART I. THE PROPERTIES OF RAW COTTON SLIVER LAP, YARN, AND FABRIC IRRADIATED UNDER VARIOUS CONDITIONS. Huo-Ping Pan, B. E. Proctor, S. A. Goldblith, H. M. Morgan, and R. Z. Naar (Massachusetts Inst. of Tech., Cambridge). PART II. EFFECTS ON CHEMICAL MODIFICATION. PART III. 2-THIOBARBITURIC ACID TEST FOR DEGRADATION. Huo-Ping Pan, B. E. Proctor, and S. A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Textile Research J. 29, 415-30(1959) May.

Sliver lap, yarn, and fabric made of the same raw cotton of known composition were irradiated with cathode rays under various conditions. Changes in chemical and physical properties were investigated. Some yarns were also irradiated with γ rays. The changes that occurred were found to be the same as those in samples irradiated with cathode rays. The tensile strength of the yarn decreased with dose. Microbiological tests showed that both yarn and fabric were sterilized by a dose of one megarep. A general increase in mildew resistance was noted in irradiated samples. A marked increase was noted in the tensile strength of yarn irradiated at 0.1 megarep and then partially acetylated. At dose levels of 10 megarep and above, sharp increases in the acetyl values of the acetylated samples were noted. Raw cotton irradiated with cathode rays was found to form color compounds with 2-thiobarbituric acid in acidic solutions. (M.C.G.)

3181 FERROMAGNETIC HYSTERESIS BY INTERSTITIAL ATOMS IN NEUTRON-IRRADIATED NICKEL. H. Kronmüller, A. Seeger, and P. Schiller (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Z. Naturforsch. 15a, 740-1(1960) Aug. (In German)

The ferromagnetic relaxation behavior of neutron-irradiated nickel was studied. The nickel was exposed to an integrated flux density nvt = 4×10^{17} cm^{-2} fast neutrons for 4 hr at a temperature of 25°C. The samples were stored in liquid air or solid carbon dioxide. The measurements of the relaxation time as a function of the reciprocal temperature after plastic deformation and neutron irradiation follow the same law $\tau = \tau_0 \exp(Q/kt)$. The activation energy was determined to be Q = 0.81 ± 0/01 ev. The migration energy of the interstitial atoms was W = 1.02 ± 0.03 ev. (J.S.R.)

3182 NUCLEAR RADIATION DAMAGE TO ELECTRONIC COMPONENTS. E. H. Cooke-Yarborough (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.159-63 of "Proceedings of the International Symposium on Electronic Components held at Malvern, Worcestershire, 24-26 September 1957." Fort Halstead, Kent, Eng., Ministry of Supply, 1958. 470p.

The susceptibility of electronic components to nuclear radiation varies with the different types of components over a range of the order of 10^{10}. Several components of various types were irradiated for 1 sec with a dose of about 10^{12} neutrons/cm^2. The majority of the components withstood this dose successfully. Electrolytic condensers showed a capacitance fall of 1 or 2%. Vacuum thermistors showed a significant change of temperature coefficient at the higher temperatures. The surviving components were irradiated to a level of 10^{15} neutrons/cm^2. After this dose some of the capacitors broke down when the rated voltage was applied. High-frequency transistors were less susceptible than low-frequency ones. Surface-barrier transistors were unaffected by doses as high as 10^{13} neutrons/cm^2. Graphs showing the test results for the various components are included. (M.C.G.)

3183 IRRADIATION OF POLYMERS. Arthur Charlesby, Solomon Harris Pinner, and Judith Burrows (to T. I. (Group Services) Ltd.). British Patent 853,737. Nov. 9, 1960.

The tensile strength, resistance to deformation, and oxidation at high temperatures (80 to 160°C), and resistance to degradation by u-v light of irradiated polyethylene can be improved by incorporating into the polyethylene prior to irradiation a filler (carbon black, silica, and china clay) and an antioxidant. The amount of filler may be anywhere from 10 to 200 parts by weight filler per 100 parts polyethylene, but the preferred range is 25 to 100 parts. For carbon black, the best particle size is 20 to 50 mμ; whereas,

for silica, grades like Aerosil are good. In the preferred method, the mixing is carried out in a Banbury mixer at 10 to 30°C above the normal melting point of the polyethylene. Nine examples are given in which the properties at room temperature and 100 and 150°C of an irradiated, compounded polyethylene are compared with those of (1) unirradiated, compounded, (2) uncompounded, irradiated, and (3) uncompounded, unirradiated polyethylenes. Another advantage of the method is that the addition of filler often reduces the radiation dosage required. (D.L.C.)

PHYSICS

General and Miscellaneous

3184 (AD-234537) THERMOELECTRIC CONVERSION OF ENERGY. Final Report (Research and Development Program) for Period: October 1, 1958 through September 30, 1959. General Electric Co., [Schenectady, N. Y.]. Oct. 23, 1959. 188p. Contract DA-44-177-Tc-525.

With the ultimate aim of converting heat from a nuclear reactor, a radioisotope source, or a chemical reaction into useful electrical energy, materials effecting this conversion were investigated. An analytical investigation of the performance of mobile ground power supplies based on the use of thermoelectric materials was conducted for the purpose of providing some guidance to the materials work as well as indicating the status of materials with respect to the requirements of mobile ground power supplies. A detailed description is given of the work performed, and the results and conclusions are summarized. (W.D.M.)

3185 (AD-235104) CONVERSION OF COBALT AND SULFUR FOIL COUNT RATES TO FLUX. R. M. Thornton. Lockheed Nuclear Products, Marietta, Ga. Mar. 1960. 25p. Contract AF33(600)-38947. (NR-75).

Derivations of the equations for converting cobalt and sulfur foil count rates to flux are presented. The equations for cobalt assume counting of the 1.33 Mev γ photopeak on a 3 × 3-in. NaI(Tl) crystal, and those for sulfur assume counting on either a 2π gas flow proportional counter or an end-window GM tube. The analysis takes into account the effects of irregular reactor power cycles of either short or long duration. An error analysis is included for estimated errors to the resultant flux values. (auth)

3186 (AD-235106) EPI-THERMAL DOSE AND ATOMIC PRODUCTION CALCULATIONS. Walter R. Burrus. Lockheed Nuclear Products, Marietta, Ga. Jan. 1960. 47p. (NR-40R).

The cross sections for energy absorption were determined for several common elements as a function of energy, and average cross sections were calculated for each of three representative reactor neutron spectra. These average cross sections vary for different spectra, but the variations for the representative spectra selected were no larger than a factor of two. Moreover, most of the cross sections vary from spectrum to spectrum in the same general manner, so comparison of one cross section with another is much more accurate than the determination of an absolute value of the average cross section. It is possible to compute the absorbed energy from the total energy flux directly by use of the average cross sections, but the most important application is the comparison of the dose in an arbitrary sample with the measured dose in a reference material. Calculation of absorbed energy from the number flux depends on a knowledge of the average energy and since the average energy is very strongly influenced by the large number of low-energy neutrons present in reactor spectra, the average energy depends largely on the low-energy response of the flux detector used. The conversion of integral flux Φ (E) (flux above energy E) to total energy flux is determined for each of the three representative spectra. The fraction of the absorbed dose effective in producing atomic displacements. was computed for several common metals. It may be multiplied by the absorbed energy to give the energy used in formation of atomic displacements. This two-step calculation has an advantage over a direct calculation of the number of atomic displacements in that the result is completely insensitive to the displacement energy and relatively insensitive to the critical ionizing energy. If the displacement energy is known, the number of atomic displacements may be found by dividing the energy used in atomic displacement production by the average energy required to produce one atomic displacement, about twice the displacement energy. (auth)

3187 (AD-236199) CALCULATION OF EQUILIBRIA IN THERMALLY IONIZED GASEOUS MIXTURES. The Saha Equation. Daniel E. Rosner. AeroChem Research Labs., Inc., Princeton, N. J. Sept. 1958. 43p. (TM-11).

The method by which equilibrium constants for ionization reactions may be computed from available spectroscopic data is discussed. Several examples are presented to illustrate the methods involved as well as the nature of the permissible assumptions. (auth)

3188 (ANL-6225) BUBBLE CHAMBER SAFETY MEETING. Joseph M. Harrer. Argonne National Lab., Ill. June 28, 1960. 19p. Contract W-31-109-eng-38. OTS.

A description is given of bubble chambers in use and those in the design stages. Safety factors in the design and operation of a bubble chamber are discussed. Data are presented on fatigue and rupture tests on glass. Data are contained on the effects of liquid helium on the tensile properties of various stainless steels. (C.J.G.)

3189 (ANL-6246) THE THERMODYNAMIC AND TRANSPORT PROPERTIES OF SODIUM AND SODIUM VAPOR. E. L. Dunning. Argonne National Lab., Ill. Oct. 1960. 32p. Contract W-31-109-eng-38. OTS.

The thermodynamic properties for the saturated and superheated phases of sodium are presented in tabular form and as a Mollier diagram. The density, thermal conductivity, viscosity, specific heat, and surface tension of the metal are given by tables and charts. The methods used in determining the properties are discussed. (auth)

3190 (BNL-4934) A STUDY OF THE DIFFUSIVE MOTIONS OF LIQUIDS BY MEANS OF COLD NEUTRON SCATTERING EXPERIMENTS. Harry Palevsky. Brookhaven National Lab., Upton, N. Y. [1960]. 22p. (IS/P-29). OTS.

[For presenation at the] IAEA Conference in Vienna on "Inelastic Scattering of Neutrons in Solids and Liquids."

Diffusive motions in water, liquid lead, and liquid tin were studied by means of cold neutron scattering. The self-diffusion rate of lead was studied at 603, 669, and 735°K and of tin at 531, 579, and 623°K. The activation energies for diffusion were 2100 and 2000 cal/mole for lead and tin, respectively. No evidence of diffusive scattering was observed with water. (C.J.G.)

3191 (CERN-60-33) A PROGRAMME FOR THE GEOMETRICAL RECONSTRUCTION OF CURVED TRACKS IN A BUBBLE CHAMBER. W. G. Moorhead. European Organization for Nuclear Research, Geneva. Sept. 2, 1960. 43p.

A description is given of the sequence of calculations for the geometrical reconstruction of each measured event following the input to the computer of the necessary information. A specification is included of the conventions and limitations imposed on the input data by the geometrical reconstruction program and the meaning of the numbers output as results. (W.D.M.)

3192 (CRNP-970) PHYSICS RESEARCH AT THE CHALK RIVER REACTORS. B. N. Brockhouse, M. A. Clark, J. W. Knowles, J. C. D. Milton, and R. N. Sinclair. Atomic Energy of Canada Ltd., Chalk River, Ont. Sept. 22, 1960. 42p. (AECL-1103). AECL.

Presented at the Symposium on Pile Neutron Research in Physics, Vienna, October 17-21, 1960.

The experiments in fundamental physics that have been carried out at the Chalk River reactors over a period of thirteen years are described. The high flux and high power of the NRX and NRU Reactors and the variety and flexibility of their experimental facilities have contributed greatly to the success of the experimental programs. Among others, systematic studies have been carried out on the disintegration of the neutron, on the details of the fission process, and on the γ ray following neutron capture. Neutron beams have been used extensively to study the structure and dynamics of solids and liquids and of magnetic materials. Several representative experiments are discussed and a comprehensive bibliography is included. (auth)

3193 (DESY-A2.65) BERECHNUNG DER HOCH-FREQUENZRINGLEITUNG. TEIL I. (Calculations for High-frequency Ring Conductors. Part I). Hassenpflug. Deutsches Elektronen-Synchrotron, Hamburg. July 14, 1960. 20p.

The ring conductors should provide h-f energy to the 16 accelerator sections so that the h-f amplitudes for the individual sections differ from each other as little as possible when the whole system is balanced. The accelerator sections are coupled to the ring conductors so that only a vacuum-tight coupling is needed. Calculations are shown for these ring conductors of the Hamburg electron synchrotron. (T.R.H.)

3194 (GA-1088) MEASUREMENT OF LOW ENERGY NEUTRON SPECTRA. J. R. Beyster, W. M. Lopez, R. E. Nather, and J. L. Wood. General Atomic Div., General Dynamics Corp., San Diego, Calif. Nov. 13, 1959. 15p. Project 48. Contract AT(04-3)-167, Project Agreement No. 2. OTS.

This is a reprint of a paper as presented by J. R. Beyster at the Winter Meeting of the American Nuclear Society, Washington, D. C., November 4-6, 1959.

A program devoted to the measurement of low-energy neutron spectra in various moderators is summarized. A 25-Mev linear electron accelerator giving a neutron source strength of 2×10^{10} neutrons/pulse was used in the experiments. The experimental arrangement is illustrated and results are given. (W.D.M.)

3195 (GAMD-1050) EPITHERMAL ABSORPTION BY CONTROL RODS OF VARIABLE BLACKNESS. J. Devooght. General Atomic Div., General Dynamics Corp., San Diego, Calif. Oct. 12, 1959. 29p. Project No. 32. Contract AT(04-3)-314. OTS.

A variational principle is given which yields directly the epithermal absorption of a variable blackness control rod for plane and cylindrical geometry. By proper choice of the analytical expression for the transparency function, the resulting expression can be given in terms of Laplace transforms. Graphs of the integrated slowing down density are provided for routine computation. (J.R.D.)

3196 (HW-50373) INDUCTIVE THERMOMETRY. T. W. Cannon. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. May 28, 1957. 20p. OTS.

The basic principles of inductive thermometry, a method of measuring temperature by electromagnetic means, are presented. It is shown analytically and experimentally that existing technology in the field of eddy-current methods of nondestructive testing may be successfully applied to determine the temperature of a metal object. An application of this method to detect lack of bonding of fuel element jackets is discussed. (W.L.H.)

3197 (ISC-1138) NITROGEN ISOTOPE ABUNDANCE MEASUREMENTS. Gregor Albert Junk and H. J. Svec. Ames Lab., Ames, Iowa. Nov. 1958. 40p. Contract W-7405-eng-82. OTS.

The abundance of the nitrogen isotopes in several sources of nitrogen has been determined. In atmospheric nitrogen the absolute ratio, N^{14}/N^{15}, is 272.0 ± 0.3. Small variations were observed for various sources of compressed gas, but the isotopic composition of the nitrogen isotopes of the atmosphere was constant (to 1 part in 7000) in samples collected at different geographical sites and altitudes above these sites. A procedure for the determination of the absolute abundance by dual collection of the 28^+ and 29^+ ion currents is given along with a method of circumventing the ever-present background problem in nitrogen abundance determinations. Proper procedures to be employed when assaying enriched nitrogen preparations and samples containing normal nitrogen mixed with another gas such as oxygen are described. (auth)

3198 (KAPL-2000-11(p.III.1-III.2)) CONTINUOUS FLUX MONITORING OF A HIGH-FLUX FACILITY WITH A^{41}. W. C. Judd. Knolls Atomic Power Lab., Schenectady, N. Y.

In an effort to improve surveillance of the flux experienced by test specimens in the HB-1 facility at the Materials Testing Reactor, neutron activation of argon gas was used to furnish a continuous flux-monitoring system. The system consisted of a tank of argon gas, flow regulators and a recorder, and a single-channel recording γ spectrometer. (W.L.H.)

3199 (LA-2304) PUBCO-II, AN IBM 704 CODE FOR COMPUTING THE IDEAL THERMODYNAMIC FUNCTIONS OF A DIATOMIC GAS MOLECULE. Lawrence R. Sitney. Los Alamos Scientific Lab., N. Mex. Mar. 1959. 80p. Contract W-7405-eng-36. OTS.

A companion code for PUBCO-I, which computes the ideal thermodynamic functions of polyatomic gas molecules, is presented. The PUBCO-II code is arranged to handle the ground electronic state plus as many as five excited electronic states with their associated vibration and rotation terms. The code normally computes the nonrigid rotator-anharmonic-oscillator thermodynamic functions but drops out the correction factors to give the rigid rotator-harmonic-oscillator thermodynamic functions if the operator so desires. The PUBCO-II code is distinguished from other codes which compute thermodynamic functions for diatomic molecules by its treatment of the rotational-energy contribution to the partition function. Three different methods of computing this contribution are used, depending on whether the molecule is in a Σ electronic state, a doublet non-Σ electronic state, or a triplet non-Σ electronic state. Sample calculations which illustrate

certain features of the code are given for OH ($^2\Pi$) and C_2 ($^3\Pi$). (See also LA-2278.) (auth)

3200 (LAMS-2457) BIBLIOGRAPHY ON MAGNETIC SUSCEPTIBILITY: (1) ACTINIDE ELEMENTS, THEIR ALLOYS AND COMPOUNDS, AND (2) METHODS AND INSTRUMENTATION. James Louie and Reed O. Elliott. Los Alamos Scientific Lab., N. Mex. Sept. 1, 1960. 99p. Contract W-7405-eng-36. OTS.

Part A of this bibliography contains 119 references on the magnetic susceptibility of the actinide elements, their alloys, and intermetallic compounds. Part B contains 102 references on methods and instrumentation for measurement of magnetic susceptibility. (C.J.G.)

3201 (MND-P-2352) FINAL SAFETY ANALYSIS REPORT—SNAP 1A RADIOISOTOPE FUELED THERMOELECTRIC GENERATOR. George P. Dix. Martin Co. Nuclear Div., Baltimore. June 30, 1960. 200p. Contract AT(30-3)-217. OTS.

The safety aspects involved in utilizing the Task 2 radioisotope-powered thermoelectric generator in a terrestrial satellite are described. It is based upon a generalized satellite mission having a 600-day orbital lifetime. A description of the basic design of the generator is presented in order to establish the analytical model. This includes the generator design, radiocerium fuel properties, and the fuel core. The transport of the generator to the launch site is examined, including the shipping cask, shipping procedures, and shipping hazards. A description of ground handling and vehicle integration is presented including preparation for fuel transfer, transfer, mating of generators to final stage, mating final stage to booster, and auxiliary support equipment. The flight vehicle is presented to complete the analytical model. Contained in this chapter are descriptions of the booster-sustainer, final stage, propellants, and built-in safety systems. The typical missile range is examined with respect to the launch complex and range safety characteristics. The shielding of the fuel is discussed and includes both dose rates and shield thicknesses required. The bare core, shielded generator, fuel transfer operation, and dose rates for accidental conditions are treated. The mechanism of re-entry from the successful mission is covered. Radiocerium inventories with respect to time and the chronology of re-entry are specifically treated. The multiplicity of conditions for aborted missions is set forth. The definition of aborted missions is treated first in order to present the initial conditions. Following this, a definition of the forces imposed upon the generator is presented. The fate of the radiocerium fuel following both successful and aborted missions is presented. A large number of initial vehicle failure cases is narrowed down into categories of consequences. Since stratospheric injection of fuel results in cases where the fuel is not contained after re-entry, an extensive discussion of the fall-out mechanism is presented. (auth)

3202 (MND-P-2373) 13-WATT CURIUM FUELED THERMOELECTRIC GENERATOR FOR A SIX-MONTH SPACE MISSION. Final Report. Justin L. Bloom. Martin Co. Nuclear Div., Baltimore. July 1960. 46p. Contract AT(30-3)-217. OTS.

The development of a design concept for a thermoelectric generator suitable for use in extraterrestrial space missions for periods up to six months is outlined. The generator derives its power from the radioactive decay of the isotope Cm^{242}. It was optimized on the basis of minimum weight consistent with environmental safety and performance requirements. It weighs about 16.6 pounds and produces 13 watts of d-c power (at 3 volts output) continuously over its six-month operational life. (auth)

3203 (NAA-SR-4710) A CODE FOR INDEXING POWDER PATTERNS. I. R. Tannenbaum, B. J. Lemke, and D. Kramer. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Nov. 1, 1960. 67p. Contract AT-11-1-GEN-8. OTS.

A code is presented for indexing powder patterns quickly and economically by adaptation of Hesse's Method for use on modern high-speed computers. The data are finally treated by Cohen's Method to obviate inaccuracies due to systematic errors. (auth)

3204 (NAA-SR-Memo-2649) STATUS REPORT: EVALUATION OF GRAPHITE FOR SNF. S. C. Carniglia. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Apr. 8, 1958. 5p. OTS.

Data on graphite neutron absorption cross sections which may be related to chemical impurity levels are presented. (J.R.D.)

3205 (NASA-TN-D-472) ANALYTICAL INVESTIGATION OF CYCLE CHARACTERISTICS FOR ADVANCED TURBOELECTRIC SPACE POWER SYSTEMS. Thomas P. Moffitt and Frederick W. Klag. National Aeronautics and Space Administration. Lewis Research Center, Cleveland. Oct. 1960. 30p. OTS.

An investigation was made of the relative influence of turbine inlet temperature, radiator temperature, and turbine efficiency on required radiator area for Rankine cycles and rubidium, potassium, and sodium as working fluids. A further analysis was made of the factors influencing turbine efficiency and design for alkali-metal applications. The effect of working fluid and rotor speed on required number of stages and the effect of moisture on efficiency are considered. Methods of reducing moisture content are compared. (auth)

3206 (NEVIS-84) AREA ANALYSIS OF NEUTRON RESONANCES. Jerome L. Rosen. Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs. Dec. 1959. 38p. Contracts AT-30-1-GEN-72 and N6-ori-110-1. (CU-189-59-ONR-1-Phys.). OTS.

The technique of area analysis of neutron resonance transmission data was extended to include the effects of both significant potential scattering interference and Doppler broadening. Numerical calculations of the area function A/Δ are presented. The Doppler broadening parameter Δ/T and the potential factor kR are varied between 0.25 to 16 and 0 to 0.565, respectively. A method of applying the present calculation to include to first order, high energy, and many-level effects is discussed. (auth)

3207 (NP-9262) SPECIFIC HEAT AND SPIN SUSCEPTIBILITY OF DILUTE ALLOYS. Technical Report No. 4. A. Houghton. California. Univ., La Jolla. [1959]. 13p. Project NR 017-630. Contract NONR-2216 (11).

The effect on the specific heat and spin susceptibility of a metal of valence Z caused by the introduction of an impurity atom with (Z + q) valence electrons is discussed largely by means of the Thomas-Fermi model. In the case of copper, the results of an exact numerical Thomas-Fermi calculation show that the specific heat and spin susceptibility are a factor of 2.5 smaller at q = 4 than a linear theory would predict. It is concluded that the qualitative dependence of the specific heat on q is given by the Thomas-Fermi theory. A check on the theory is made by calculating the specific heat and spin susceptibility using the techniques of many body perturbation theory. (auth)

3208 (NP-9329) THE THERMIONIC ENERGY CONVERTER. Technical Report 373. W. B. Nottingham. Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics. Sept. 9, 1960. 48p.

The general theory of a plasma diode energy converter is presented. Equations are presented for determining the electron injection energy directly from the following parameters: work-function of the emitter, emitter temperature, condensation of the cesium supply, and an estimation concerning the average temperature of the gas in the space between the emitter and the collector. Equations are presented for determining the probable fraction of the cesium concentration that is ionized in the plasma space. It is shown that under suitable conditions, a positive ion space-charge sheath forms in the immediate neighborhood of the emitter, and, as a result of this space-charge situation, electrons are accelerated from the emitter into the intervening space. In this space plasma oscillations develop and the electron-energy distribution changes to a quasi-Maxwell-Boltzmann distribution characterized by a temperature of 5000°K or more. A method is presented for the computation of the electrical properties of a close-space thermionic converter. The theoretical background by which the performance characteristics of the high-vacuum diode can be evaluated in terms of emitter temperature, spacing between emitter and collector, and work-function of the collector is presented. (C.J.G.)

3209 (NP-9331) NUCLEAR RELAXATION AND DYNAMIC POLARIZATION IN SOLIDS. Technical Report No. 3. P. L. Scott. California. Univ., Berkeley. June 1, 1960. 28p. Project No. NR 017-723. Contract Nonr 222(61).

Mechanisms for relaxation and dynamic polarization of nuclei in a solid containing a small percentage of paramagnetic impurities are proposed. Spatial diffusion of nuclear polarization is taken into account, and its effects on both the transient and steady-state behavior of the average polarization are determined for a simple model. (C.J.G.)

3210 (NP-9348) A SPACE BIBLIOGRAPHY THROUGH 1958. Raymond Estep. Air Univ. Research Studies Inst., Maxwell AFB, Ala. 1959. 112p.

A bibliography containing 1832 references is presented on aspects of space travel. References are contained on astronomy, missile installations, communications, control and guidance systems; performance of various missiles, rockets, satellites, and rocket-powered aircraft; orbits and trajectories; propulsion systems; space law; and space medicine. (C.J.G.)

3211 (NP-9377) TIME DEPENDENCE OF MÖSSBAUER TRANSMISSION. Technical Report No. 20. S. M. Harris. Illinois. Univ., Urbana. Oct. 1960. 64p. Contract Nonr 1834 (05).

In a time-dependent experiment, the transmitted 14.4-kev photon from Fe^{57} was measured in delayed coincidence with the 122-kev photon. The spectrum of transmitted radiation gave information on the temporal aspects of the emission and absorption processes involved, with well-defined initial conditions. The dependence of the line shape of the transmitted radiation on the delay time is considered. (W.D.M.)

3212 (NP-9378) SOLAR POWER SOURCES FOR SATELLITE APPLICATIONS. Hans K. Ziegler. Army Signal Engineering Labs., Fort Monmouth, N. J. [1957]. 10p.

For presentation at CSAGI Rocket and Satellite Conference, September 30–October 5, 1957.

A summary of progress in the 20 months beginning Jan. 1956 on development of solar power sources for satellites is presented. It is noted that as a practical result of the over-all progress to date, silicon-type solar power supplies were designed and produced for use in Vanguard test spheres. (J.R.D.)

3213 (NP-9425) PARAMAGNETIC RESONANCE HYPERFINE STRUCTURE OF TETRAVALENT Pa^{231} IN Cs_2ZrCl_6. Technical Report No. 5. J. D. Axe, H. J. Stapleton, and C. D. Jeffries. California. Univ., Berkeley. Oct. 1960. 33p. Project No. NR 017-723. Contract Nonr 222(61).

Paramagnetic resonance absorption at 3-cm wavelengths was observed for tetravalent Pa^{231} in a single crystal of Cs_2ZrCl_6 at helium temperatures. The observed spectra corresponded to the allowed transitions (S_z, $I_z \rightarrow S_z \pm 1$, I_z) and the forbidden transitions (S_z, $I_z \rightarrow S_z \pm 1$, $I_z \mp 1$) of a system described by the spin Hamiltonian $H_s = g\beta\underline{H} \cdot \underline{S} + A\underline{I} \cdot \underline{S} - g'_n \beta\underline{H} \cdot \underline{I}$, with $S = {}^1/_2$, $I = {}^5/_2$, $|A|/h = 1,578.6 \pm 1.4$ Mc/sec, $|g| = 1.1423 \pm 0.0014$, and $|g'_n| \approx 8 \times 10^{-4}$. The errors indicated a small deviation from isotropy. It was further observed that $g'_n/g < 0$, indicating that if g'_n is positive, as is strongly indicated by the nuclear shell model, then g is negative. An additional electron-nuclear double resonance experiment was used to determine directly the nuclear magnetic moment $\mu(Pa^{231}) = 1.96$ nuclear magnetons. This value includes a correction of 9% due to perturbations of an excited state about 1900 cm^{-1} above the ground state doublet of Pa^{4+} in its octahedral crystal field. A lower frequency double resonance experiment was used to measure the weak hyperfine interaction of the Pa^{4+} ion with its Cs^{133} neighbors, of order $A''/h \approx 0.5$ Mc/sec. (auth)

3214 (ORO-327) IONIZATION CROSS SECTIONS IN THE ENERGY RANGE 0.15–1.10 MEV. PHASE I: H^+ IONS INCIDENT ON H_2 TARGETS. Technical Status Report No. 4 (First Annual Report) Covering the Period September 1, 1959 to August 31, 1960. E. W. McDaniel, D. W. Martin, J. W. Hooper, and D. S. Harmer. Georgia Inst. of Tech., Atlanta. Engineering Experiment Station. Sept. 1, 1960. 37p. Project No. B-176. Contract AT(40-1)-2591. OTS.

Measurements were made of the ionization cross section for protons incident on H_2 at 0.15 to 1.10 Mev. The results were in excellent agreement with a Born-approximation calculation. (C.J.G.)

3215 (SCR-212) INTERPRETATION AND PREDICTION OF RADAR TERRAIN RETURN FADING SPECTRA. Progress Report No. 1. Peter D. Welch. New Mexico Coll. of Agriculture and Mechanic Arts, State College. Physical Science Lab. July 1960. 67p. For Sandia Corp. OTS.

Reprinted from AER-14W, dated May 25, 1955.

Activities in a program to elucidate the behavior of airborne radar illuminating the terrain beneath it are reported. A review of information on the first probability distributions and their moments is presented. Preliminary data indicate that the general problem of predicting d-c/a-c ratio and variance spectrum of the pulse-to-pulse fluctuations in a specified type of terrain, the radar parameters, and the flight-path velocity characteristics can be solved. This will permit calculation of fading spectra by relatively simple calculations. (J.R.D.)

3216 (SCR-225) EIGEN COUPLING FACTORS AND PRINCIPAL COMPONENTS, THE THERMODYNAMIC INVARIANTS OF PIEZOELECTRICITY. H. G. Baerwald. Sandia Corp., Albuquerque, N. Mex. Sept. 1960. 9p. OTS.

Presented at 1960 IRE International Convention, March 21-24, 1960, New York.

A thermodynamically invariant representation of piezoelectricity is reviewed in which the emphasis is placed on the function of transduction between the electrical and mechanical forms of power. Expressions representing the invariant schemes of a PZT ceramic and of quartz are included. (J.R.D.)

3217 (SCTM-281-60(51)) CHARACTERISTICS OF A FREE SUPERSONIC HELIUM JET ISSUING NORMALLY FROM A FLAT PLATE. Anthony Bedford. Sandia Corp., Albuquerque, N. Mex. Aug. 25, 1960. 48p. OTS.

Axial and radial pressure surveys were made across Mach 2, 3, and 4 helium jets issuing from a circular, flat plate (simulated ground plane). The axial jet thrust and the induced pressure on the plate were measured. (auth)

3218 (SM-37637) SOME NOTES ON THERMOELECTRIC EFFECTS. MODEL—GENERAL. L. L. Schilb. Douglas Aircraft Co., Inc., Santa Monica, Calif. July 1, 1960. 40p.

The thermodynamic principles of the thermoelectric phenomenon are discussed. Methods of cooling and power generation utilizing thermoelectric effects are discussed. Computer programs are presented for thermoelectric cooling and thermoelectric generators in space. (C.J.G.)

3219 (SRB-60-10) THE THEORY AND APPLICATIONS OF SIGNAL-FLOW GRAPHS. An Annotated Bibliography. G. R. Evans and J. L. Burroughs, comps. Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif. Sept. 1960. 30p. OTS.

Results of a search of 83 references to obtain information on the applications of signal flow graphs are presented. References on the theory of these graphs are also included. (J.R.D.)

3220 (TID-6301) A STUDY OF CREEP DEFORMATION OF HEMISPHERICAL THIN SHELLS. [PART] I. Annual Report. K. N. Tong. Syracuse Univ., N. Y. Research Inst. July 1960. 27p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract No. 913. (ME683-607F). OTS.

A study is presented of possible methods for analyzing the creep deformation of axially symmetrical thin shells subjected to a uniform external pressure. The final objective of the study is to predict the creep life of hemispherical shells. It is contended that creep buckling of hemispherical shells can take place only after a change in the shell shape due to creep deformation; thus it is necessary to study axially symmetrical shells in general. (W.L.H.)

3221 (TID-6507) A REPORT ON RESEARCH AND DEVELOPMENT DURING THE PERIOD MAY 1, 1959 TO AUGUST 1, 1960. Robert K. Adair, Earle C. Fowler, Henry L. Kraybill, and Horace D. Taft. Yale Univ., New Haven. Aug. 12, 1960. 15p. Contract AT(30-1)-2341. OTS.

The major purpose of this work was to provide Yale University with an automatic precision-measuring projector known as a "Franckenstein," a major facility for the rapid and accurate measurements of bubble-chamber photographs. (W.L.H.)

3222 (UCRL-5685(Rev.)) A SIMULATOR FOR HIGH-DENSITY ION GUNS. Raymond Fox. California. Univ., Livermore. Lawrence Radiation Lab. Apr. 1960. 17p. Contract W-7405-eng-48. OTS.

A simulator for an ion gun is used to predict the ion trajectories in the gun for a given electrode geometry. One simulator control is used for the space-charge simulation of the entire ion beam. The beam is divided into cells of different areas in such a manner that each cell has the same space charge. Potential measurements are made at the boundaries of the cells where the accuracy of the space-charge simulation is the greatest. A trajectory plotter is described which consists of a miniature tricycle, a voltage balancing unit (the same as used in d-c millivolt recorders), a d-c regulated power supply, and a number of resistors. The trajectories are found by "steering" the tricycle across the simulator. The trajectory plotter and the method of space charge simulation were checked experimentally and were found to have good accuracy. (auth)

3223 (UCRL-6171-T) CORRECTION TO THE DEBYE-HÜCKEL THEORY. John G. Trulio and Stephen G. Brush. California. Univ., Livermore. Lawrence Radiation Lab. Oct. 7, 1960. 4p. Contract W-7405-eng-48. OTS.

Further development of a method for calculating the correlation energy of a classical one-component electron gas is discussed. (J.R.D.)

3224 (UCRL-9414) VIBRATIONAL STATES OF THE HD^+ AND HT^+ IONS. Stanley Cohen, John R. Hiskes, and Robert J. Riddell, Jr. California. Univ., Berkeley. Lawrence Radiation Lab. Sept. 29, 1960. 5p. Contract W-7405-eng-48. OTS.

The vibrational eigenvalues belonging to the ground electronic state of the HD^+ and HT^+ ions were calculated. These calculations were done for the $J = 0$ rotational state, neglecting the dynamic corrections to the potential. For the HD^+ ion twenty-two bound states were found, and for the HT^+ ion, twenty-three bound states. (auth)

3225 (WADD-TR-60-128) THERMIONIC ENERGY CONVERTER. Walter L. Knecht. Wright Air Development Div. Electronic Technology Lab., Wright-Patterson AFB, Ohio. Feb. 10, 1960. 55p. Project No. 4156. (AD-236038).

High-vacuum and gas-filled thermionic energy converters are reviewed. Emphasis is placed on the significant phenomena underlying the operation of these two classes of converters. A treatment of fundamental thermionic-emitter characteristics is given. The complex variety of simultaneous processes occurring in the plasma of gas-filled converters is illustrated. Principal problem areas existing in the field of both converter types are shown. The present state of the art in this field is discussed in connection with the results obtained with small-sized device samples developed to date. Further applications of thermionic converters are projected. Reference is made to the current need for continued applied-research efforts aimed at advancing from the presently available thermal-conversion efficiency of about 10% up to the theoretically feasible level of approximately 30%. (auth)

3226 (WIN-120) RADIOACTIVITY STATISTICS. Topical Report. A. S. Goldin. National Lead Co., Inc. Winchester Lab., Winchester, Mass. Nov. 1, 1960. 14p. Contract AT(49-6)-924. OTS.

The principles of radioactivity counting statistics are reviewed with particular application to the problems of low-level counting. Application of these statistical principles to actual problems which have been encountered, particularly in Ra^{226} determinations, is given. (auth)

3227 (AEC-tr-4314) ABSORPTION SPECTRUM OF LIQUID OXYGEN IN ARGONNE AND KRYPTON MIXTURES

(11000–3300 Å). V. I. Dianov-Klokov. Translated from Optika i Spektroskopiya 1, 863-6(1956). 11p. (Includes original, 6p.). JCL or LC.

An investigation was made of the dependence of the absorption spectral-band intensities of liquid oxygen on the molar concentration (CO_2) in argon and krypton mixtures at T = 77.8°K in the region of 10,600-3300A. The extinction band coefficients depend on CO_2 nonlinearly and differently for each of the atmospheres (N_2, krypton, and argon). In the rarification of liquid oxygen, its spectrum weakens as a whole, while the half-width and band form remain constant. An exception to this is the group of least forbidden bands at 7640A and 6890A ($^3\Sigma - {}^1\Sigma$), the intensity of which increases relatively for small CO_2 values, whereupon in mixtures with N_2 the effect is observed for oxygen concentrations larger than in mixtures with argon. The observed phenomena are clarified if it is assumed that the investigated absorption spectrum corresponds only to the interaction between the oxygen molecules while N_2, krypton, and argon are "neutral" admixtures. (auth)

3228 (AEC-tr-4319) ABSORPTION SPECTRUM OF LIQUID OXYGEN AND OF ITS MIXTURES WITH NITROGEN IN THE REGION 10,600-2800 Å. V. I. Dianov-Klokov. Translated from Optika i Spektroskopiya 1, 650-7(1956). 15p. (Includes original, 8p.). JCL or LC.

Measurements were made of the spectral-band absorption indices of liquid oxygen at 10,600 to 3,000 A. The distribution of intensities confirms the validity of grouping the bands according to the Ellis-Kneser scheme. Preliminary measurement results of the temperature-intensity dependence indicate that the bands corresponding, according to Ellis and Kneser, to the symmetric di-electron transitions are the most sensitive to temperature changes. The absorption band intensities of liquid oxygen, mixed with nitrogen, change more sharply than quadradically, as a function of the oxygen content in the mixture. In this case, the nature of the dependence is maintained quite uniformly for all the bands, except 7640 and 6890 A ($^3\Sigma - {}^1\Sigma$). For these, a relative intensity function apparently associated with less rigid forbiddenness laws of this transition, is observed in mixtures with a low oxygen content. There have been found two new absorption bands: the 5-M and 6-M terms of the Ellis-Kneser grouping $^2\,{}^3\Sigma - 2'\,\Sigma$ and also three new longer wave terms of the "triplet" progression. In the region of 3,000 to 3,050 A, an overlapping of the bands of the "triplet" series and of the Ellis-Kneser bands was observed. (auth)

3229 (CEA-tr-A-479) FAISCEAUX D'ATOMES ET DE MOLÉCULES CONDENSÉS DANS LE VIDE POUSSÉ. (Beams of Atoms and Molecules Condensed in Vacuum). E. W. Becker, K. Bier, and W. Henkes. Translated into French from Z. Physik 146, 333-8(1956). 17p.

In time-of-flight studies of velocity distributions in a Laval H_2 beam, a discontinuity was observed which was related to an extraordinary increase in beam intensity. The possibility of transferring the condensed regions of the beam in a vacuum and directly measuring their velocity distribution is investigated. (T.R.H.)

3230 (CEA-tr-A-730) DÉTERMINATION DE L'ÉMISSION NEUTRONIQUE D'UNE SOURCE DE NEUTRONS. (Determination of the Neutron Emission of A Neutron Source). P. Wunderer. Translated into French from Z. angew. Phys. 12, 537-46(1958). 36p.

Measurements were made of the absolute neutron emission of a 100-mc Ra-α-Be neutron source and a 25-c Po-α-Be source. The neutrons emitted were moderated and absorbed in an $MnSO_4$ solution. In a portion of the solution the manganese was precipitated and dried, and its activity was measured with a standardized γ-counting tube. From a known ratio of the cross section of H_2 to manganese the source emission was calculated. The γ-counting tube was standardized against an Mn^{56} solution the activity of which was measured with a 4π counter. The cross section ratio σ_H/σ_{Mn} was found by measuring the thermal-neutron distribution in water and in the $MnSO_4$ solution. Neutron resonance capture by manganese was determined from the neutron-flux distribution at the gold resonance in water and in the $MnSO_4$ solution. Corrections were applied for neutron absorption by sulfur, oxygen, and the source material. A correction was also made for the number of neutrons escaping from the solution. (T.R.H.)

3231 (JPRS-5790) SOME COMMENTS ON RADIATION BY SHOCK WAVES IN COSMIC CONDITIONS. (Nekotorye Zamechanira ob Izluchenii Sveta Udarnymi Volnami v Kosmicheskikh Usloviyakh). S. A. Kaplan and I. A. Klimishin. Translated from Astron. Zhur. 37, 281-3(1960). 9p. OTS.

The heating of a gas that precedes a shock wave by radiation from the shock wave is studied by means of the theory of light scattering in a medium with moving boundaries. Equations are given for calculating the temperature distribution in the heated zone and the width of this zone. (auth)

3232 (JPRS-5786) ENERGY DISTRIBUTION OF GAMMA-RAY QUANTA IN THE ATMOSPHERIC LAYER NEAR THE EARTH'S SURFACE. (Raspredeleniye -Kvantov po Energii v Prizemnon Sloye Atmosfery). R. M. Kogan and Sh. D. Friedman. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., 530-47(1960). 41p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 18329.

3233 (JPRS-5145) LINEARIZED PROBLEM ON THE PROPAGATION OF A STRONG EXPLOSION IN A NON-HOMOGENEOUS ATMOSPHERE. V. P. Karlikov. Translated from Vestnik Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim. No. 4, 27-39(1959). 21p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 14218.

3234 (UCRL-Trans-563(L)) A SIMPLIFIED PROOF OF WICK'S THEOREM IN STATISTICAL MECHANICS. Michel Gaudin. Translated from Nuclear Phys. 15, 89-91 (1960). 3p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 10989.

3235 (UCRL-Trans-571) A SOURCE OF POLARIZED PROTONS ACTUAL STATE OF CONSTRUCTION. (Une Source de Protons Polarises — Etat Actuel de la Construction). R. Keller, L. Dick, and M. Fidecaro. European Organization for Nuclear Research, Geneva. Translated by B. Harvey from report CERN-60-2, Jan. 29, 1960. 56p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 10105.

3236 THE ENTROPY OF SPIN SYSTEMS IN MAGNETIC NUCLEAR RESONANCE. [PART] I. Günter Vojta (Karl-Marx-Universität, Leipzig and Institut für Physikalische Stofftrennung, Deutsche Akademie der Wissenschaften, Leipzig). Ann. Physik (7) 6, 31-43(1960). (In German)

With the help of density matrix calculus of quantum statistics, the entropy for various spin systems which are found under the simultaneous influence of a constant and a high frequency magnetic field in stationary nonequilibrium

states is explicitly calculated. After a discussion of the concepts of entropy and temperature in the thermodynamics of irreversible processes, the incompatibility of the Wangsness entropy definition with the usual entropy concepts is indicated, and it is shown that the principle of the minimum entropy production in the presence of magnetic nuclear resonance phenomena is not directly valid. (tr-auth)

3237 MEASUREMENTS OF SECONDARY ELECTRON EMISSIONS IN KCl AND KBr. Bernhard Petzel (Heinrich-Hertz-Institut für Schwingungsforschung, Deutsche Akademie der Wissenschaften, Berlin-Adlershof). Ann. Physik (7) 6, 55-66(1960). (In German)

Measurements of the secondary electron emission in KCl and KBr single crystals and in a KCl vapor-deposited layer were made by the single-pulse method. The yield values measured were compared with the dependence of the yield on the temperature resulting from the Dekker theory. At higher energies E_p of the primary electrons δ decreases with increasing temperatures between room temperature and 300°C; it is almost inversely proportional to the root of the absolute temperature. At small primary energies the yield is temperature dependent. The energy distribution of the secondary electrons depends on the primary energy; the number of electrons with low energy increases with the primary energy in proportion to the number of superfluous electrons. (tr-auth)

3238 SECONDARY ELECTRON EMISSION OF ANTIMONY–CESIUM AND BISMUTH–CESIUM LAYERS OF VARIOUS COMPOSITIONS. G. Appelt and O. Hachenberg (Heinrich-Hertz-Institut für Schwingungsforschung, Deutsche Akademie der Wissenschaften, Berlin-Adlershof). Ann. Physik (7) 6, 67-81(1960). (In German)

Measurements of the yield, its temperature dependence, and the energy distribution of secondary electrons in Sb–Cs and Bi–Cs layers of various compositions were made. In addition to the already frequently studied Cs_3–Sb with a high yield, the cesium-poor compound CsSb was measured. Its yield is temperature independent and only slightly greater than that of antimony. For the Bi–Cs system similar compounds (Cs_3Bi and CsBi) with approximately equal secondary-electron-emission behavior exist. The curves of the energy distribution of the secondary electrons for Sb–Cs and Bi–Cs layers resemble each other very strongly. With increasing cesium concentration the half-value width of the curves decreases very strongly, and simultaneously the maximum shift to lower energies occurs. The discussion leads to the conclusion that the change of the yield in the single forming state appears to be produced chiefly by the change of the work function and the A_IB_V compounds represent a group whose high yield values are traced back to a low potential threshold at the surface. (tr-auth)

3239 SECONDARY ELECTRON EMISSION OF ANTIMONY–RUBIDIUM LAYERS. W. Kaneff (Heinrich-Hertz-Institut, Deutsche Akademie der Wissenschaften, Berlin-Adlershof). Ann. Physik (7) 6, 82-8(1960). (In German)

Static measurements of the secondary electron emission were made on polycrystalline vapor-deposited Sb–Rb layers of various stoichiometric compositions. The study of the yield, the temperature dependence of the yield, and the energy distribution of the secondary electrons show that in contrast to the frequently studied Sb–Cs layers, no essential variation in the secondary electron emission occurred. In the Sb–Rb layers the higher the rubidium concentration, the higher the energies at which the yield maximum occurs. With increasing activation of the pure antimony by rubidium atoms, the number of slow secondary electrons increases and has a displacement of the maxima of the energy distribution curves to small energy values as a result. The yield in the forming states I ($RbSb_2$) and II (Rb_3Sb) is almost temperature independent. (tr-auth)

3240 ELECTRON ENERGY LEVELS IN CRYSTALS. I. THALLIUM-ACTIVATED ALKALI HALOGENIDES. M. Balarin (Univ. of Leningrad). Ann Physik (7) 6, 120-30(1960). (In German)

With the help of the central ion model the effect of various alkali halogenide primary crystals on the electron terms was investigated. For thallium-activated crystal phosphors it was assumed by Seitz that an activator is substituted for a normal cation. It was shown that regularities which have been known for a long time from experimental work are given also by the theory when the lattice ions are regarded not as point charges but are considered the spatial distribution of the electron clouds. These conclusions were discussed and contrasted with other works. An antlytical approximation used for the "non-point" charge of halogen and alkali ions is given in an appendix. (tr-auth)

3241 THEORETICAL INVESTIGATIONS ON THE BEHAVIOR OF CHARGED PARTICLES AT THE SADDLE POINT OF ELECTRIC ALTERNATING FIELDS. Adolf Müller (Wissenschaftlich-Technisches Büro für Reaktorbau, Berlin-Pankow). Ann. Physik (7) 6, 206-20(1960). (In German)

The motion of a charged particle in electric alternating and constant fields was studied by consideration of friction and the earth's field. Of special interest were periodic solutions of the (nonlinear) motion equation on the symmetry axes of plane and axially symmetrical potential fields in the vicinity of the saddle point. The conditions under which the charged particle can hang free at the point of an alternating field are given. The behavior of two charged particles in the symmetry plane of axially symmetrical potentials was also studied. A new measurement method was given for the determination of charge and mass of particles. (tr-auth)

3242 AN APPROXIMATE CALCULATION OF THE MEAN ENERGY OF THE ELECTRONS EJECTED BY γ-RAYS IN AN IONIZATION CHAMBER. A. K. Val'ter, M. L. Gol'din, and V. I. Slavin. Atomnaya Energ. 9, 135-6 (1960) Aug. (In Russian)

Calculations are made of energies of electrons ejected from lead by Co^{60} and Cs^{137} γ quanta. A method for detecting photo- and Compton-produced electrons with an ionization chamber is given, and the experimental and calculated magnitudes of mean electron energies in the ionization chamber are tabulated. (R.V.J.)

3243 PROGRAM FOR THE REFINEMENT OF CRYSTALLINE STRUCTURES WITH AN ELECTRONIC MACHINE. F. Roche and P. Mériel (Centre d'Études Nucléaires, Saclay, France). Bull soc. franç. minérol. et cryst. 82, 273-6 (1959). (In French). (CEA-1358)

A program was developed by means of which the positions of atoms in a crystal lattice can be accurately determined from a powder spectrum using the method of least squares. The enveloping group must be known, as well as the approximate positions of the atoms in the lattice. (auth)

3244 A PROTON SOURCE WITH MULTIPLE BEAMS. Gaston Olive. Compt. rend. 251, 1474-6(1960) Oct. 10. (In French)

A source of protons with high-frequency ionization was

constructed to be used for injection into a mirror machine. The extraction system permits several extraction tunnels, assuring the formation of parallel jets with high density nonperturbed by the space charge. The source discharges continuously up to 13.5 mamp with a good energy yield and a low loss of neutral gas. (tr-auth)

3245 FABRICATION OF AN IONOGRAPHIC EMULSION IN THE PRESENCE OF AN EXCESS OF Ag^+ IONS. François Simon. Compt. rend. 251, 1774-6(1960) Oct. 24. (In French)

The fabrication processes of an ionographic emulsion during which the concentration of the Ag^+ ions is controlled at each instant is described. An attempt is made to define the optimum value of this parameter in order to obtain the best sensitivity and the least clouding. The emulsions obtained are sensitized by triethanol amine either by remelting or soaking. (tr-auth)

3246 INVERSION OPERATIONS IN QUANTUM FIELD THEORY. J. Leite Lopes (Universidade do Brazil, Rio de Janeiro). Contribs. cient. Univ. Buenos Aires, Fac. cienc. exact. y nats., Ser. fis. 1, 147-226(1960). (In English)

A series of lectures given at the Facultad De Ciencias Exactas y Naturales, University of Buenos Aires, Argentina, in October and November 1959 are presented. Topics discussed include the following: a review of foundations of quantum field theory; space reflections and parity; Bose fields, space reflection and parity; Fermi fields; particle-antiparticle conjugation; Majorana neutral fields; parity of Majorana neutral fermions; time reversal; and strong reflection. (M.C.G.)

3247 THE ROLE OF INTERNAL SENSITIVITY CENTERS IN NUCLEAR EMULSIONS. J. Beneš and J. Kubal (Inst. for Nuclear Research, Czechloslovak Academy of Sciences, Prague). Czechoslov. J. Phys. 10, 612-13(1960). (In German)

A series of nuclear emulsions was prepared in which the silver centers were formed in microcrystals by photolytic decomposition of silver halides with short, intense exposures (Latensification). The exposures (50,000 lux. sec.) were given at intervals of 0, 7, 14, and 21 minutes during emulsification. This showed that the sensitivity centers lie at different depths. This finding was used to study distribution of latent images from light and ionizing radiation. From such experiments it was found that latent images destroy more slowly in emulsions with sensitivity centers. A study of sensitization by triethanolamine is also reported. (T.R.H.)

3248 GLOW DISCHARGE INFRARED SPECTRUM. A. L. Stolov and N. R. Dolgopolova (State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedenií, Fiz. No. 3, 154-7(1960). (In Russian)

The infrared spectrum of high pressure glow charge in carbon dioxide coincides with the spectrum of a CO diffusion flame. Lines pertaining to NO, NO_2, and N_2O_4 molecules are found in the discharge spectrum in air. The probability of oscillating quantum transmission in CO_2 molecule collisions is equal to 0.2 to 10^{-4}. (tr-auth)

3249 SHOCK WAVE STRUCTURE IN RELATIVISTIC CASE. S. S. Moiseev (Poltava Agricultural Engineering Inst., [USSR]). Izvest. Vysshikh Ucheb. Zavedenií, Fiz. No. 3, 158-64(1960). (In Russian)

The behavior of relativistic shock waves was studied, and the wave structure was determined by a relativistic kinetic equation. An expression for the distribution function inside the shock wave was found and evaluated for the transition from nonrelativistic to relativistic. (R.V.J.)

3250 SINGULAR SOLUTION OF SPINOR EQUATION AND ELECTRON THEORY. L. E. Lebedev (Dnepropetrovsk State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedenií, Fiz. No. 4, 22-9(1960). (In Russian)

A generalized Dirac equation for free electrons was developed on the basis of a new concept of the ψ function. The ψ field source was introduced. The resolving equation is developed and analyzed. New results are found for the classical convergence of electron self energy; the presence of specific quantum bond energy; and the presence of excited (virtual) electron energy. The new concept leads to a new interpretation of atomic theory and a new concept of the physical nature of stationary states. (R.V.J.)

3251 MAGNETIC RESONANCE IN SYSTEMS WITH SIMULTANEOUS ELECTRON AND NUCLEAR PARAMAGNETISM. A. A. Kokin (Urals Polytechnic Inst., [USSR]). Izvest. Vysshikh Ucheb. Zavedenií, Fiz. No. 4, 198-205 (1960). (In Russian)

Nuclear resonance in paramagnetic solutions and metals and the influence of surrounding nuclei on electron resonance were studied on the basis of a previously developed theory of magnetic resonance in systems with two types of magnetic moments. (tr-auth)

3252 STUDY OF THE RELAXATION OF A PARAMAGNETIC ION BY OBSERVATION OF THE NUCLEAR RESONANCE SIGNALS. André Landesman (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 20, 937-48(1959) Dec. (In French). (CEA-1488)

Dynamic polarization of protons in water containing the paramagnetic ion $NO(SO_3)_2$ was studied, both theoretically and experimentally, as a function of magnetic field. The enhancement of the proton polarization depends appreciably on the relaxation process of the electron spin and so enables us to decide which is the real relaxation process. The two following processes were used: the electron spin is coupled with the nitrogen magnetic moment by hyperfine interaction; if this interaction has an anisotropic part, a relaxation process for the electronic spin will result through the Brownian motion of the ion; and the relaxation of the electron spin takes place through spin-orbit coupling of the electron spin. Experimental results showed that the relaxation took place through the second process. With the help of dynamic polarization the relaxation of an electron spin was studied in a liquid without using any electron resonance spectrometer, simply by observing the resonance of a nuclear spin coupled with the electron spin. (auth)

3253 STRUCTURE RESEARCH WITH THE HELP OF NEUTRON DIFFRACTION. Gernot Lutz (Institut für Kristallographie, Munich). Kerntechnik 2, 271-5(1960) Sept. (In German)

Problems on structure research solved with neutron diffraction are reviewed. Examples of general structure analysis in which supplementary and more accurate data are obtained from neutron diffraction are first discussed; results on the clarification of the magnetic structure are then discussed. (tr-auth)

3254 THE OUTER RADIATION BELT AND AURORAE. Harold Liemohn (Boeing Scientific Research Labs., Seattle, Wash.). Nature 188, 394-5(1960) Oct. 29.

Diurnal variations were observed in the latitude of the hydrogen lines in auroras at College, Alaska. The variation is approximately sinusoidal with latitude minima at

local midnight. The magnitude of the shift during geomagnetically quiet periods requires the solar wind to penetrate to within 4 to 5 earth radii from the center of the earth. This corresponds to a translational kinetic energy density of about 300 to 600 kev/cm^3 for the wind, which is within the energy range suggested by other measurements. The position of the belt must have a diurnal variation such that the tips are always over the auroral regions at night, and the day side is slightly compressed from the usual dipole shape by the solar wind. The meager space-probe observations of the belt are tabulated and tend to support the unsymmetric model. (B.O.G.)

3255 NEW C14 STANDARD. Nuclear Energy, 493 (1960) Oct.

A new National Bureau of Standards C^{14} standard was prepared for liquid scintillation counters using toluene and xylene as solvents and consists of benzoic acid-7-C^{14} dissolved in toluene. Standardization of the standard was carried out by oxidizing it, collecting the CO_2, and comparing its activity in an ionization chamber to that of CO_2 prepared from the national sodium carbonate-C^{14} standard. (D.L.C.)

3256 PLASTIC SCINTILLATORS. Józef Andruszkiewicz, Witold Kuźma, and Zenon Polacki (Technical Univ., Danzig). Nukleonika 5, 575-82(1960). (In Polish)

Plastic scintillators p-terphenyl + POPOP in polystyrene were produced. The dependence of detection efficiency upon composition of scintillators, in order to define the optimum concentration of ingredients, was investigated. It was confirmed that when using the photomultiplier PEU-19, the optimum composition is 3% p-terphenyl and 0.025% POPOP. The dependence of detection efficiency upon scintillator size was investigated. The efficiency (pulse height) of the plastic scintillators was 0.44% that of anthracene. (auth)

3257 HAAG'S THEOREM IN A FINITE VOLUME. P. Federbush (Massachusetts Inst. of Tech., Cambridge). Nuovo cimento (10) 15, 932-3(1960) Mar. (In English)

The question of extending Haag's theorem to a finite volume is explored. A positive result is suggested. (auth)

3258 EXCITON-INDUCED PHOTOCONDUCTIVITY IN Cu_2O. J. H. Apfel and A. M. Portis (Univ. of California, Berkeley). Phys. and Chem. Solids 15, 33-8(1960) Aug. (In English)

Structure in the photoconductivity spectrum of Cu_2O was observed which corresponds to the "yellow" exciton series observed in optical absorption. From the fact that the photoconductivity in the exciton peaks is initially stimulated by illumination and then quenched, it is concluded that distinct electronic processes are associated with the exciton-induced photoconductivity. The most likely mechanism is excitation of localized carriers by excitons. The experimental evidence is insufficient to establish that the excitons are mobile. A comparison of d-c and microwave conductivity measurements of Cu_2O established that the conductivity is limited by barriers. (auth)

3259 THE EFFECT OF PRESSURE ON THE ABSORPTION SPECTRA OF ALKALI HALIDE PHOSPHORS. R. A. Eppler and H. G. Drickamer (Univ. of Illinois, Urbana). Phys. and Chem. Solids 15, 112-18(1960) Aug. (In English)

The effect of pressure (over 150,000 atm.) was measured on the spectra of 26 alkali halide phosphors, including nine doped with Tl^+, two doped with In^+, twelve doped with Pb^{+2}, two doped with Cu^{+2}, and one doped with Bi^{+3}. ν_{max} for the Tl^+-doped phosphors depended very strongly on the crystal structure and very little, if any, on the halide ion involved, which was consistent with the Seitz model. The In^+-doped phosphors behaved like the Tl^+ analogs. For the Pb^{+2} phosphors, the shift of ν_{max} depended very strongly on the halide ion, and only incidentally on the lattice structure. This was consistent with the complex model. (auth)

3260 PARAMAGNETIC STUDY OF YTTRIUM AND RARE-EARTH FERRITES OF THE FORMULA $5Fe_2O_3 \cdot 3M_2O_3$. Roland Aléonard (Laboratoire d'Électrostatique et de Physique du Métal, Grenoble, France). Phys. and Chem. Solids 15, 167-82(1960) Aug. (In French)

The paramagnetic susceptibilities of the ferrites of formula $5Fe_2O_3 \cdot 3M_2O_3$ with garnet structure were measured between the Curie point and 1500°K, for M = Y, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu. The experimental results can be interpreted on the basis of Néel's theory of ferrimagnetism. The curve of the reciprocal susceptibility as a function of temperature is of the third or second degree, for magnetic and nonmagnetic M ions, respectively. From these curves, the molecular field coefficients, which are a measure of the interactions between the magnetic ions, can be determined, as well as their temperature coefficient. (auth)

3261 EFFECTIVE CHARGE OF HEAVY IONS IN VARIOUS MEDIA. P. G. Roll and F. E. Steigert (Yale Univ., New Haven). Phys. Rev. 120, 470-3(1960) Oct. 15.

Effective-charge data for heavy ions, as obtained from range-energy curves in oxygen, argon, aluminum, and nickel, are analyzed in terms of a Fermi-Thomas representation of the atom. It would appear that this gives a superior parametrization in terms of nuclear charge. In addition, it appears to properly account for the increase in charge observed for metallic as compared to gaseous absorbers. (auth)

3262 STATISTICAL MECHANICS FOR THE NON-IDEAL BOSE GAS. A. E. Glassgold, A. N. Kaufman, and K. M. Watson (Univ. of California, Berkeley). Phys. Rev. 120, 660-74(1960) Nov. 1. (UCRL-9149)

The equilibrium and quasi-equilibrium properties of a system of interacting bosons are studied from a microscopic point of view. For equilibrium, the model of Bogolyubov is generalized to finite temperature by using the grand partition function. The thermodynamic properties and the pair-correlation function are calculated. The statistical mechanics for moving systems is developed and applied to the problem of a rotating fluid. For quasi-equilibrium, general transport equations are derived from first principles, independent of statistics and model. For the Bogolyubov model, the familiar two-fluid hydrodynamics is derived, leading to the phenomena of first and second sound. (auth)

3263 TEMPERATURE DEPENDENCE OF THE LOW-MOMENTUM EXCITATIONS IN A BOSE GAS OF HARD SPHERES. F. Mohling (Cornell Univ., Ithaca, N. Y.) and M. Morita. Phys. Rev. 120, 681-8(1960) Nov. 1.

The pseudopotential method is used to calculate the temperature dependence of the low-momentum excitations in a Bose gas of hard spheres to an order beyond that previously known. The correction term is shown to be small compared to the leading term for all temperatures less than the critical temperature T_c. The excitations become poorly defined for temperatures slightly below T_c, since it is shown that in this region the excitation lifetimes are quite small. (auth)

3264 THERMAL CONDUCTION IN ROTATING LIQUID HELIUM II. C. E. Chase (Massachusetts Inst. of Tech., Lexington). Phys. Rev. 120, 688-96(1960) Nov. 1.

When a heat current flows in a wide channel filled with liquid helium II, the resulting temperature gradient is approximately proportional to the cube of the heat current density. The establishment of this gradient requires a time τ which is a function of heat current, temperature, and past history of the helium. The present experiments concern the effect of uniform slow rotation, about an axis normal to the direction of heat flow, upon gradT and τ. GradT was measured at 0 and 1.3 rads/sec, the highest angular velocity at which this measurement could conveniently be carried out. No effect of rotation could be observed; however, an approximate calculation suggests that gradT might increase detectably at somewhat higher rates of rotation. τ was measured at a number of angular velocities between 0 and 4 rads/sec; it was found that τ was appreciably reduced by rotation, the effect being greatest at small heat currents and high angular velocities. These results can be explained on the assumption that mutual friction results from turbulence in the superfluid component, taking the form of a tangled mass of vortex line. The delay time, τ, characterizes the rate of growth of this turbulence when a heat current is switched on; rotation reduces τ by introducing an initial length of vortex line which accelerates this growth. (auth)

3265 PHOSPHORESCENCE MECHANISMS. I. APPROACH AND GENERAL ANALYSIS. C. Billington (Commonwealth Scientific and Industrial Research Organization, Chemical Research Labs., Melbourne). Phys. Rev. 120, 697-701(1960) Nov. 1.

A new technique is described for the study of decay mechanisms in phosphors. When a phosphor is excited by radiation with an intensity modulated to a depth <10%, the modulation of the emission intensity has negligible harmonic content. Quantitative comparisons of these two modulated signals, if of sufficient accuracy and range, result in qualitative distinctions between different basic mechanisms and the possibility of subsequent quantitative analysis. In particular monomolecular and bimolecular processes are unequivocally distinguished. (auth)

3266 PHOSPHORESCENCE MECHANISMS. II. DESCRIPTION OF PHOSPHOROMETER. C. Billington (Commonwealth Scientific and Industrial Research Organization, Chemical Research Labs., Melbourne). Phys. Rev. 120, 702-7(1960) Nov. 1.

The functions of the phosphorometer are to excite the phosphor under test with ultraviolet radiation whose intensity is modulated sinusoidally, to measure the modulation frequency, and to sample the excitation and emission intensities and to extract from their modulated components the in-phase attenuation factor between them. The mercury arc source is current-modulated and stabilized by optical feedback over the range 3 to 30,000 cps. The average intensity of both excitation and emission is used to control the sensitivity of their respective photodetectors so that the modulation signals are always referred to the same datum. Both signals are passed in turn through a homodyne detector with the phase adjusted to identity with the excitation modulation. The in-phase attenuation factor, which is the ratio of the homodyne outputs, is determined potentiometrically with a probable error of about 0.002. (auth)

3267 PHOSPHORESCENCE MECHANISMS. III. METHOD OF ANALYSIS. C. Billington (Commonwealth Scientific and Industrial Research Organization, Chemical Research Labs., Melbourne). Phys. Rev. 120, 708-9(1960) Nov. 1.

The method of deconvolution is discussed for the case in which phosphorescence is distributed between a number of concurrent components with different rate constants. The resolution of the method is deduced quantitatively from the known root mean square difference of the apparatus. (auth)

3268 PHOSPHORESCENCE MECHANISMS. IV. DECAY RATE SPECTRA OF RUBY, URANIUM GLASS, AND Mn-ACTIVATED ZINC SULFIDE. C. Billington (Commonwealth Scientific and Industrial Research Organization, Chemical Research Labs., Melbourne). Phys. Rev. 120, 710-14(1960) Nov. 1.

Ruby, uranium glass, and a ZnS-Mn sample were studied by means of the phosphorometer in a program of measurement and analysis which included variation of temperature and average exciting intensity. It was not possible to identify any laws of temperature dependence, but there is strong evidence that part of the phosphorescence mechanisms operating in the ZnS-Mn sample involves recombination. (auth)

3269 QUANTUM MECHANICAL LAW OF CORRESPONDING STATES FOR VAN DER WAALS SOLIDS AT 0°K. Newton Bernardes (Ames Lab., Ames, Iowa). Phys. Rev. 120, 807-13(1960) Nov. 1. (IS-142)

A quantum mechanical variational treatment based on a simple Heitler-London wave function is used to describe the various properties of Van der Waals solids at 0°K. The effects of nuclear motion on the cohesive energy, volume, compressibility, sound velocity, etc., are discussed. These effects can be expressed in the form of a power series in $\hbar$, of which we show the first term, linear in $\hbar$, explicitly. The results are in good agreement with the available experimental data for all solidified inert gases, except for helium to which the present method is not applicable. (auth)

3270 ELASTIC AND INELASTIC SCATTERING OF ELECTRONS FROM THE S STATES OF ATOMIC HYDROGEN. Kenneth Smith (Argonne National Lab., Ill.). Phys. Rev. 120, 845-7(1960) Nov. 1. (BNL-4581)

Total elastic and inelastic cross sections for the scattering of electrons (including exchange) from the 1s, 2s, and 3s states of atomic hydrogen was calculated in three approximations using the method of partial waves. The purpose of this report is to present the S-, P-, and D-wave contributions to the elastic, $Q_{1s\text{-}1s}$, and inelastic, $Q_{1s\text{-}2s}$, cross sections. (auth)

3271 RESONANCE BROADENING OF SPECTRAL LINES. C. Alden Mead (Univ. of Minnesota, Minneapolis). Phys. Rev. 120, 860-6(1960) Nov. 1.

A formalism introduced previously is used to calculate the shape of an absorption line in a gas, considering the "resonance" interaction between like atoms. The most serious approximation is the neglect of the effect of translational motion. An asymmetric line is obtained, with the maximum shifted slightly toward the red. Some simple classical considerations agree qualitatively with the results. Various properties of the line shape obtained are discussed. The neglect of translational motion makes it impossible to compare the results with experiments performed up to the present time. (auth)

3272 DIVERGENCE-FREE ITERATIVE EXPANSION OF THE S MATRIX IN A FIELD THEORY. Kurt Haller

(New York Univ., New York). Phys. Rev. 120, 1045-57 (1960) Nov. 1.

A new method is proposed for evaluating the S-matrix as a series expansion in powers of the coupling constant. The method is applicable to field theories which in the usual formulation have ultraviolet divergences in self-energy and vertex parts and require self-energy, coupling constant, and wave-function renormalization. The procedure cannot be applied in its present form to theories which allow boson self-energy terms. In this new procedure the usual form of the hamiltonian for the coupled system is retained. The theory results in an iterated solution in powers of the physical coupling constant and yields a series, each term of which is finite without subtractions or renormalization. It agrees up to all orders examined with the finite S-matrix elements obtained by renormalizing the old formulation of the scattering problem. It is shown that the nth order contribution to the iterative expansion of the S matrix, where n is any order, approaches 0 more rapidly at high energy than $E^{-(2-\delta)}$ where δ is any positive real number, no matter how small. (auth)

3273 FLUORESCENCE AND REFLECTION SPECTRA OF NaI SINGLE CRYSTALS. W. J. Van Sciver (Levinthal Electronic Products, Inc., Palo Alto, Calif.). Phys. Rev. 120, 1193-1205(1960) Nov. 15.

The fluorescence emission and excitation, reflection, and transmission spectra of 22 different NaI crystal samples grown in crucibles of Pt or quartz under atmospheres of N_2 or H_2 or H_2 plus I_2 and in some cases containing stoichiometric excess of Na or I_2 or containing various concentrations of Tl, were explored from 2.5 to 8 ev. At −190°C an emission band centered at 295 mμ (4.20 ev) was observed in all but the one sample which contained the highest Tl concentration (0.1 mole %). Another emission band at 375 mμ (3.31 ev) was found to be strongest in crystals containing excess I_2. A 425 mμ (2.92 ev), emission appeared strongly in all crystals containing Tl, but a 325 mμ (3.82 ev) band appeared only in the one crystal with 0.1 mole % Tl. With excitation energy below 5.5 ev, the different emission bands arose from discrete excitation bands. With excitation energies above 5.5 ev up to 8 ev the emission was primarily in the 295-mμ band until Tl concentration reached 0.05 mole % where the 425-mμ band and 295-mμ band became approximately equal. Maxima in reflection spectra coincide closely but not exactly with published maxima in the absorption spectra of NaI evaporated films. An inflation, not seen in the published absorption spectra, appeared at 5.62 ev in the reflection spectrum at −190°C. Coincidental with the lowest energy maximum in the reflection spectrum at 5.59 ev the excitation spectra for both 295-mμ and 425-mμ emission exhibited minima too strong to be accounted for by reflection loss. At excitation energies of 5.7 ev and above, luminescence quantum efficiency was greatest for an illuminating angle of incidence of 45°; whereas, at lower energies no definitely preferable incidence angle was found. Also with higher exciting energies it was found that the emission was strongest on the axis of illumination. With exciting energies below 5.5 ev, the emission was isotropic. (auth)

3274 STUDY OF THE SURFACE STATES OF DIAMOND AND GRAPHITE BY A SIMPLE MO-LCAO METHOD. J. Koutecký and M. Tomášek (Inst. of Physical Chemistry, Czechoslovak Academy of Sciences, Prague). Phys. Rev. 120, 1212-18(1960) Nov. 15.

The surface states of diamond and two-dimensional graphite were investigated on the assumption that the delimitation of the crystal causes no perturbation within the elementary cells of the finite crystal. In both cases a plane perpendicular to the bond between a selected pair of carbon atoms was taken as the delimiting plane. The molecular orbitals were assumed in the form of a linear combination of sp^3 or sp^2 hybrids. In the case of graphite, molecular orbitals that are linear combinations of $2p_z$ orbitals, whose interaction with sp^2 hybrids is neglected, are further considered. It appeared that in the case of diamond there exists a band of energies pertaining to Shockley surface states in the gap between the valence and conductivity bands. The number of atoms in this band equals the number of atoms in the surface. From a discussion of the pertinent wave functions, it follows that these states are an expression of unsaturated bonds of the surface carbon atoms. The electron density on the hybrids projecting from the surface is essentially greater than the density on the other hybrids of the surface atoms. Further bands of surface states exist in the region of energies allowed for the volume valence and the conductivity states. In graphite, a quite analogous behavior was shown by those surface states whose wave functions are linear combinations of sp^2 orbitals. Surface states whose wave functions are linear combinations of p_z orbitals are a manifestation of unsaturated double bonds of surface atoms having only two neighbors. The analogy between these Shockley states and the nonbonding states of odd alternant aromatic hydrocarbons is pointed out. (auth)

3275 EXPERIMENTS ON CHARGE-CHANGING COLLISIONS OF LITHIUM IONIC AND ATOMIC BEAMS. S. K. Allison, J. Cuevas, and M. Garcia-Muñoz (Univ. of Chicago). Phys. Rev. 120, 1266-78(1960) Nov. 15.

Beams of Li^+ ions accelerated to kinetic energies in the range 10 to 475 kev were brought into charge equilibrium in the gases H_2, He, and N_2 and the fractional amounts of Li^-, Li^0, Li^+, Li^{+2}, and Li^{+3} measured. Because of the relatively large amount of Li^- in an equilibrated beam below 40 kev in energy in propane and nitrous oxide, limited investigations were carried out in these gases. The anomalously large Li^{+2} yield in helium at Li^+ energies below 100 kev was noted. By holding each separated charged constituent successively in an orbit in a magnetic field, admitting gas, and observing the beam attenuation, the total cross section for all charge-changing collisions was observed. Through application of the differential equations for growth or decay of a charged component, certain individual charge-changing cross sections can be deduced from these observed sums. Values are given for $(\sigma_{10}^- + \sigma_{11}^-)$, σ_{21}, σ_{10}, σ_{12}, σ_{21}, and $(\sigma_{32} + \sigma_{31})$ in H_2, He, and N_2 target gases throughout the energy range. Upper limits can be assigned to σ_{01}^-, σ_{11}^-, σ_{13}, and σ_{23}. Use of data on σ_{11}^- in H_2 from other sources provides values of σ_{01}^- in that gas. Values for σ_{21} for Li^{+2} in helium gas, compared at common velocities with σ_{10} for He^+ in helium and σ_{01}^- for H^0 in helium, show the exchange nature of the He^+He interaction compared to that of the other isoelectronic structures. (auth)

3276 HYPERFINE STRUCTURE OF HYDROGEN, DEUTERIUM, AND TRITIUM. L. Wilmer Anderson, Francis M. Pipkin, and James C. Baird, Jr. (Harvard Univ., Cambridge, Mass.). Phys. Rev. 120, 1279-89(1960) Nov. 15.

The optical transmission of an optically oriented rubidium vapor in spin-exchange equilibrium with atomic hydrogen, deuterium, and tritium was used to measure with high precision the hyperfine splittings of these paramagnetic atoms. The results are $\Delta\nu(H) = 1420.405726 \pm 0.000030$ Mc/sec, $\Delta\nu(D) = 327.384349 \pm 0.000005$ Mc/sec,

and $\Delta\nu(T) = 1516.701396 \pm 0.000030$ Mc/sec. These results are based on a value of the hyperfine splitting of Cs^{133}, which is taken to be $\Delta\nu(Cs^{133}) = 9192.631840$ Mc/sec. These measurements were made in various buffer gases that caused a shift in the observed hyperfine splitting, and the results given represent extrapolations to zero pressure. The pressure shifts were measured for hydrogen in argon, neon, helium, and molecular hydrogen and were measured for deuterium and tritium in argon and neon. The assigned limits of error represent the range of disagreement of the zero-pressure extrapolations in the different buffer gases. (auth)

3277 POSITRONIUM DECAY IN MOLECULAR SUBSTANCES. Werner Brandt (Du Pont Experimental Station, Wilmington, Del.), S. Berko, and W. W. Walker. Phys. Rev. 120, 1289-95(1960) Nov. 15.

The overlap of the positron component of the wave function of positronium in dense molecular substances with the lattice wave function determines the 2γ annihilation rate of positrons bound in orthopositronium via electron pickup from the lattice (τ_2 decay) and in part the 2γ angular correlation. Positronium acts as a probe for the dependence of one-particle wave functions in lattices on structural lattice parameters and of radical-molecule interactions on atomic lattice parameters. To explore the sensitivity of this probe, positronium wave functions are calculated for different lattice structures in the Wigner-Seitz approximation, and the dependence of τ_2 decay on lattice parameters is derived. This dependence was tested experimentally by τ_2 measurements on carefully characterized molecular substances in different physical states. It was confirmed that the temperature and state dependence is primarily a "free volume" effect in the sense that the overlap between the positronium and lattice wave functions decreases with increasing lattice spacing. The effects of a spherical confinement on the self-annihilation rates and stability of positronium are shown to be small for radii relevant to molecular lattices. An anomalous behavior is found for the ice-water transition, where τ_2 increases significantly despite the contraction of water between the melting point and 4°C. (auth)

3278 PHOTOCONDUCTIVITY AND ABSORPTION OF POLYCRYSTALLINE CdS AND CdSe IN X-RAY SPECTRA. A. I. Shirvaites, V. I. Denis, and P. P. Brazdzhyunas (Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). Trudy Akad. Nauk Litovskoĭ S.S.R., Ser. B No. 2, 33-46(1960) Sept. (In Russian)

The photoresistance current from CdS is in direct proportion to the absorbed x-ray energy; the maximum is found at $\Delta = 0.5$ to 0.6 mm copper. The photoresistance of CdS is photosensitive along the whole volume. The dependence of CdSe photoresistance current on radiation energy is much less than that of CdS. In the interval $\Delta = 0.4$ to 1.4 mm copper the photocurrent remains practically constant. The experimental and theoretical data on CdS, CdSe, and CdTe photoresistance are in good agreement. The CdS and CdSe photoresistance can be used in x-ray dosimetry. (R.V.J.)

3279 PHOTOCONDUCTIVITY OF CdS AND CdSe POLYCRYSTALS DURING γ IRRADIATION. A. I. Shirvaitis, V. I. Denis, and M. V. Kavetskite (Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). Trudy Akad. Nauk Litovskoĭ S.S.R., Ser. B No. 2, 47-59 (1960) Sept. (In Russian)

The photoconductivity of activated (copper and silver) and nonactivated CdS and CdSe polycrystals irradiated by γ rays was studied. A stationary γ installation with a power of 0 to 17 r/min was used as the γ source. The dosimetric characteristics of CdS photoresistance are linear; the increase in photocurrent follows an exponential law. All photoresistances from CdSe are sublinear and the photocurrent increases parabolically. The drop in photoresistances of either group is hyperbolic. The photocurrent inertia is reduced with increased dosage, while the parameter α of the diminishing hyperbola increases; α for CdS photoresistance increases linearly while for CdSe it remains constant. An anomalous course in photocurrent rise is due to the levels sticking in forbidden zones. The photocurrent relaxation time θ_0 differs from the current carrier lifetime τ. (R.V.J.)

3280 RESULTS OF LOW TEMPERATURE RESEARCH. XXXII. THE ATOMIC AND ELECTRON HEAT OF VANADIUM AND NIOBIUM BETWEEN 10° AND 273°K. Klaus Clusius, Paolo Franzosini, and Ulrich Piesbergen (Universität, Zurich). Z. Naturforsch. 15a, 728-34(1960) Aug. (In German).

The atomic and electron heats of vanadium and niobium between 10 and 273°K were measured, and the normal entropy was determined to be 6.85 ± 0.05 for vanadium and 8.58 ± 0.05 Clausius for niobium. For the coefficient γ (in cal/degree^2 × g-atom) of the electron heat a value of 16.0×10^{-4} was found in vanadium under 20°K and 15.5×10^{-4} over 100°K. The appropriate characteristic temperatures (θ) were 425 and 419° respectively. Niobium had a strong temperature dependence of the γ coefficient. Under 14°K γ was 22.5×10^{-4} at a θ value of 250°, and over 100°K the corresponding values are 5.2×10^{-4} and 286°. (tr-auth)

3281 CONFIRMATION OF THE ABNORMALLY HIGH CONCENTRATION OF Xe^{129} IN RICHARDTON. Peter Signer (Univ. of Minnesota, Minneapolis). Z. Naturforsch. 15a, 748-9(1960) Aug. (In German)

Reynolds found a Xe^{129} excess of approximately 50% in the Richardton chondrite. To confirm these results, five independent measurements were made on 0.8- to 1.5-g samples of Richardton. The conditions for the extraction and measurements of the Xe^{129} are described in detail. The mean values of the five measurements with respect to the 132 mass, as they were read by two independent observers, are tabulated. The results are in good agreement with those of Reynolds and confirm that the Xe^{129} in Richardton is enriched at least 40% with respect to atmospheric xenon. (J.S.R.)

3282 ORGANIC LIQUID SCINTILLATORS. Manfred Wilk (Universität, Frankfurt am Main). Z. Naturforsch. 15a, 806-10(1960) Sept. (In German)

The basic studies of Kallmann led recently, generally by empirical methods, to the discovery of numerous organic liquid scintillators, which have found utilization in the measurement of high-energy particles and those with very low radiation energy. In the present study, an attempt is made to give a relationship between the chemical constitution and the scintillation properties of some organic compounds. (tr-auth)

3283 THE MEASUREMENT OF TOTAL CROSS SECTION OF SOLID NEON AND ARGON WITH VERY SLOW NEUTRONS. Tasso Springer (Technische Hochschule, Munich) and Werner Wiedemann. Z. Naturforsch. 15a, 828-30(1960) Sept. (In German)

The total cross section of solid neon at 20°K and of solid argon at 77 and 20°K with monoenergetic neutrons between 3×10^{-4} and 2.6×10^{-3} ev was measured in transmission

study. With consideration of the condition that the theoretically estimated non-elastic scattering produces only a small contribution to the total cross section, the absorption cross section is obtained. Extrapolation by the 1/v law to neutrons with v = 2200 m/sec (0.025 ev) gives for neon σ_a(2200 m/sec) ≃ 0.038 ± 0.007 b. With respect to the uncertainty in the knowledge of the scattering contribution, this value with the given error range should be regarded as an upper limit. For the incoherent scattering on neon an upper limit $\sigma_{incoh} < 0.1$ b. For argon $\sigma_a = 0.61 \pm 0.03$ b is obtained in agreement with other results. (tr-auth)

3284 THE EFFECTS OF INFRARED RADIATION ON TRAPPED ELECTRONS IN EXCITED ZnS-PHOSPHORS. B. Kramer and M. Schön (Technische Hochschule, Munich). Z. Physik 160, 145-8(1960). (In English)

By means of rise curves the number of trapped electrons in ZnS phosphors can be determined. The effect of infrared irradiation added simultaneously to ultraviolet excitation is that of quenching; in addition, the number of occupied traps (n_t) is found to be considerably reduced, approximately in the same ratio as the reduction of light. Since the free electron concentration (n) is also quenched by the addition of infrared to ultraviolet, there is some difficulty with the relationship: Light = constant × n × n_t. (auth)

3285 COMPOSITION OF THE IONS PRODUCED DURING THE IONIZATION OF GASES BY NEGATIVE IONS. Ya. M. Fogel, A. G. Koval, Yu. Z. Levchenko, and A. F. Khodyachikh (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 548-55(1960) Sept. (In Russian)

The slow ions produced by 10 to 50 kev H^- and O^- ions in He, Ne, Ar, Kr, Xe, H_2, N_2, and O_2 were analyzed with a mass spectrometer. The data of the present investigation, as well as those of a preceding study in which the total cross sections for positive ion formation were measured, were employed to calculate the cross sections for ionization involving the detachment of a definite number of electrons from the atom. The effective cross sections for production of slow ions with various charges by H^- and H^+ ions are compared. (auth)

3286 THE STRUCTURE OF LOW INTENSITY SHOCK WAVES IN MAGNETOHYDRODYNAMICS. E. P. Sirotina and S. I. Syrovatskiĭ. Zhur. Eksptl'. i Teoret. Fiz. 39, 746-53(1960) Sept.

A general expression was deduced for the width of shock waves of low intensity in magnetohydrodynamics. The damping coefficient for small amplitude waves was determined and its relation to the discontinuity width was established. (auth)

3287 DEDUCTION OF THE RADIAL EQUATIONS OF THE THEORY OF COLLISIONS BETWEEN ELECTRONS AND ATOMS. L. A. Vaĭnshteĭn and I. I. Sobel'man (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 767-75(1960) Sept.

Radial equations were derived which describe the excitation of an arbitrary level of a many-electron atom. An account was made for nonorthogonality of the wave functions of the external and optical electrons. The well-known nonuniqueness, which appears when approximate atomic wave functions are used, is discussed. An approximate form of the equations is proposed, which is based on the neglection of terms which simultaneously contain nonorthogonality integrals and higher multipole interactions. In this approximation the nonuniqueness disappears if semi-empirical wave functions for the optical electron are employed. (auth)

3288 PARAMETRIC OPTIMIZATION OF THE EMISSION-LIMITED THERMIONIC CONVERTER. N. S. Rasor (Atomics International, Canoga Park, Calif.). Paper No. 1283-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 13p.

It is proposed to establish the maximum energy conversion efficiency obtainable from the thermionic converter, as well as the input and output parameters characterizing such a fully optimized converter. The thermionic energy converter is defined as a system in which the conversion of heat to electrical energy occurs primarily by direct thermal excitation of charged particles at the surface of an electrode. There are two major classes of phenomena that affect the performance of the thermionic converter: emission effects and transport effects. The emission effects are defined as those which limit the current density received by the anode from the cathode to $J_c = AT_c^2 \exp[-e(V_o + \phi_a)/kT_c]$. The transport effects are defined as particle interactions in the interelectrode space causing the cathode-to-anode current to depart from J_c. By the use of the foregoing definition of the thermionic converter, J_c can only be decreased by transport effects. Any limitations imposed by emission effects are inherent and essential to thermionic conversion, whereas transport limitations are nonessential and in principle may be eliminated. The ultimate conversion efficiency may thus be established by optimizing all the parameters that determine the efficiency of the emission-limited converter. (B.O.G.)

3289 THE THERMIONIC POWER CONVERTER AND ITS APPLICATIONS. James G. Leisenring (General Electric Co., Philadelphia). Paper No. 159C. New York, Society of Automotive Engineers, Inc., 1960. 29p.

A simplified description of the thermionic converter and its operating principles are presented to provide a basis for the discussion of thermionic converter applications. The converter may be used as an electrical power generator or high-temperature sensor in space, airborne, ground, or sub-surface systems. In many of these systems, the heat source selected may be chemical, nuclear, or solar energy. Application requirements and limitations are discussed for these various systems. (auth)

Astrophysics and Cosmology

3290 (AFSWC-TR-59-62) A SURVEY OF MAGNETOHYDRODYNAMIC PROCESSES IN SUPERNOVAE. Julian Reinheimer. Republic Aviation Corp. Missile Systems Div., Mineola, N. Y. Sept. 1959. 62p. Project No. 7811. Contract AF29(601)-1218. (MSD-206-953-1)

General properties of supernovae and the specific properties of a few supernovae are presented. General theories concerning the origin, radiation, and expansion of supernovae are discussed, and an attempt is made to interpret these processes in terms of magnetohydrodynamics. The phenomena of supernovae and those of the expansion of the debris resulting from a thermonuclear detonation are compared. (auth)

3291 THE H^3 AND Ar^{39} IN IRON METEORITES. L. K. Levskiĭ. Radiokhimiya 2, 491-4(1960). (In Russian)

The tritium and Ar^{39} activity in the iron meteorite Sikhote-Alin (which fell in Feb. 1947) was found to be 2.4×10^{-2} and 5.7×10^{-3} decays per gram per minute, respec-

tively. On the basis of the measured activity and the content of Ar^{38} in the meteorite, the irradiation time of Sikhote-Alin was calculated as 430×10^6 years. (R.V.J.)

3292 THE ELECTROMAGNETIC ENVIRONMENT OF THE ATMOSPHERE AND NEARER SPACE. Walter Dieminger (Universität, Göttingen, Ger.). p.91-9 of "Physics and Medicine of the Atmosphere and Space." Otis O. Benson, Jr. and Hubertus Strughold, eds. New York, John Wiley & Sons, Inc., 1960.

The facts revealed by ground and upper atmosphere investigations are reviewed. The magnetic field is briefly discussed, and it is stated that variations in the magnetic field are produced by large electric currents in regions of high conductivity at ionospheric heights of 100 to 300 km. The regular part of these variations is produced by the dynamo action of the sun and moon gravitational fields, while the irregular part is produced by solar corpuscles. Factors determining the electric conductivity of the upper atmosphere are discussed. The refraction power of the ionosphere for radio waves is also discussed. Knowledge of the atmosphere at altitudes above 500 km is almost nil, but some estimates on the nature of the nearer space are offered. From observations on zodiacal light, whistler propagation, and satellite retardation, it appears that the earth moves inside the outskirts of the solar corona and that, moving toward the sun, the density decreases to a minimum of $\sim 10^3$ molecules/cm^3 at a distance of 5 to 10 earth radii and then increases again toward the sun. The effects of solar corpuscles (sweeping out cavities in the interstellar magnetic field in which cosmic rays may be trapped and forming a ring current at 5 earth radii from the earth) are treated. It is concluded that the only serious obstacle to interplanetary travel is the necessity of using very high frequencies in communication systems because of the refraction of radio waves of long wavelength in the ionosphere. (D.L.C.)

Cosmic Radiation

3293 (AFCRC-TN-60-283) VARIATIONS OF THE SEA LEVEL MUON FLUX. Technical Note No. 1. P. V. O'Connor and A. W. Wolfendale. Durham, England. Univ. Jan. 26, 1960. 25p. Contract AF61(052)-27.

A cosmic-ray spectrograph that uses a solid iron magnet with Geiger counters as detecting elements is described. The instrument was applied to study the variations of the μ-meson flux at sea level with direction and time as a function of momentum. The pressure coefficients of the μ-meson flux for three bands of momenta having median values of 2.9, 4.5, and 8.6 Bev/c were determined to be 0.25, 0.15, and 0.11 mb^{-1}, respectively. (C.J.G.)

3294 (AFSWC-TR-60-9) RADIATION MEASUREMENTS TO 1,500 KILOMETERS WITH ATLAS PODS. Francis E. Holly. Air Force Special Weapons Center, Kirtland AFB, N. Mex. May 1960. 76p. Project No. 7811. (AD-238837).

Three instrument packages, each containing eight geiger tubes, were flown into the inner Van Allen belt. Various absorber thicknesses were used to obtain range spectra for penetrating particles. Less than 1% of the radiation penetrated 150 mg/cm^2 of aluminum. The electron spectrum is consistent with a degraded neutron-albedo spectrum, and it has a high energy cutoff at approximately 800 kev. The proton spectrum was taken to be of the form $N = -N_1 E^n$ with n's calculated, at various points during each flight, using data from a pair of counters. The value of n is altitude and/or magnetic field dependent. At points of deepest penetration into the radiation, for two flights (980 and 1100 km) $n = 1.42^{+.07}_{-.09}$ and $n = -1.68^{+0.41}_{-0.38}$, respectively. The proton component penetrating 30 mg/cm^2 aluminum absorber was less than 3^{+3}_{-2}% of the total radiation. For radiation penetrating 1.7 mg/cm^2 of mica and 36 mg/cm^2 of aluminum no protons were observed within accuracies of 5 and 10%, respectively. Absolute flux intensities were calculated. The angular distribution of the radiation penetrating the latter two absorbers was observed to be of no greater half-width than 14° ± 3°. (auth)

3295 ANGULAR DISTRIBUTION OF JETS PRODUCED BY PRIMARY HEAVY NUCLEI. Elena Balea, Erwin M. Friedländer, Constanta Potoceanu, and Maria Sahini (Institutul de Fizică Atomică, Academia R. P. R., Bucharest). Compt. rend. 251, 1487-9(1960) Oct. 10. (In French)

The results of a study of 53 jets produced by primary cosmic nuclei of charge $Z \geq 2$ are reported. The angular distribution of the jets was analyzed in $x = \log \operatorname{tg} \theta$ coordinates. Twenty-two jets are described by the two-center model, nine by the multi-center model, and the rest by a single Gaussian curve of dispersion close to 0.36. The Lorentz factors, the common Lorentz factor, the dispersion of x, and the bimodality coefficient were calculated. The results suggest that in the energy range from 30 to 600 bev, direct interactions with pions of the meson cloud of the nucleons participating in the nuclei-nuclei collisions play a significant role in the multiple generation of mesons. (J.S.R.)

3296 ELECTRON NUMBER DISTRIBUTION IN ELECTRON-PHOTON SHOWERS IN AIR AND ALUMINIUM ABSORBERS. J. C. Butcher and H. Messel (Univ. of Sydney). Nuclear Phys. 20, 15-128(1960) Oct. (2). (In English)

Numerical results for the number distribution, average numbers, and variance of electrons above a given energy due to primary electrons and photons are presented for air and aluminum absorbers. The 276 tables cover the cases for electron and photon primary energies E_0 = 50, 100, 200, 500, 1000, 2000, 5000, 10,000, 20,000, and 50,000 Mev, and electron secondary energies E = 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10,000, and 20,000 Mev with depths ranging from zero to 10 radiation lengths. The more accurate Bethe-Heitler cross sections at low energies were used. Collision losses and Compton effect were taken into account. Scattering at low energies was neglected for the present low atomic number absorbers. The results were obtained using Monte Carlo methods on the electronic digital computer SILLIAC. In every case at least 1000 showers were followed to obtain the present numerical values. (auth)

3297 SLOW-NEUTRON INTENSITY AT HIGH BALLOON ALTITUDES. R. C. Haymes and S. A. Korff (New York Univ., New York). Phys. Rev. 120, 1460-2(1960) Nov. 15.

In order to extend measurements of cosmic neutrons to top balloon altitudes, a flight was conducted on August 24, 1959, in which a system of identical counters filled with enriched and natural $B^{10}F_3$ was used. An altitude of 122,000 ft at a geomagnetic latitude of 55°N was attained, corresponding to 4-mb pressure, which is considerably higher than previous measurements. The counting rate dropped to about 1% of the maximum rate, which occurs at 60,000 ft. If this curve is extrapolated to the top of the atmosphere, an upper bound for the slow-neutron albedo of 0.03 neutron per cm^2-sec is obtained. The background owing to highly ionizing events in the counters increased

exponentially to about 63,000 ft, with a derived mean free path of 152 g/cm^2. The background continued an exponential increase up to 122,000 ft but with a mean free path of 15 g/cm^2. (auth)

3298 THE DAILY PERIOD OF COSMIC RADIATION. W. Messerschmidt (Universität, Berlin and Arbeitsstelle f. Kosmische Strahlung, Deutsche Akademie der Wissenschaften, Halle, Ger.). Z. Naturforsch. 15a, 734-6(1960) Aug. (In German)

The cosmic-radiation data obtained all over the world during the International Geophysical Year were analyzed with respect to the magnetic latitude and the local time at which the data were obtained. The results were graphed. The daily period of cosmic radiation has a world-wide character. An anisotropy of the primary radiation exists which, under certain conditions, persists several days and whose maximum with phase shifting up to several hours conforms to the sun. This extends to the energetic part of the radiation since the daily period under 14 mwe is a percentage greater than at the earth's surface. The various occurrences of the large daily period over or under the earth indicate oscillations in the energy distribution in the anisotropy of the radiation. (J.S.R.)

3299 LATERAL DISTRIBUTION OF HIGH ENERGY NUCLEAR-ACTIVE PARTICLES IN THE CORE OF EXTENSIVE ATMOSPHERIC SHOWERS. A. A. Emel'yanov and O. I. Dovzhenko (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 814-21(1960) Sept.

The lateral distribution of high energy nuclear-active particles in the core of extensive atmospheric showers was considered. The mean square radius for nuclear-active particles with energies $\gtrsim 5 \cdot 10^{11}$ ev was computed from the angular distribution of secondary particles emitted in multiple production processes as predicted by the Landau hydrodynamic theory. It is shown that the magnitude of the mean square radius is not only determined by the angles of emission of the secondary particles during multiple production but by diffraction scattering of the nuclear-active particles on nuclei of air atoms as well. (auth)

3300 EFFECTS OF INTERPLANETARY DUST AND RADIATION ENVIRONMENT ON SPACE VEHICLES. S. Fred Singer (Univ. of Maryland, College Park). p.60-90 of "Physics and Medicine of the Atmosphere and Space." Otis O. Benson, Jr. and Hubertus Strughold, eds. New York, John Wiley & Sons, Inc., 1960.

The probable effects of micrometeoric erosion, sputtering, cosmic rays, and radiation belts on space vehicles are discussed with a view to designing radiation shielding. The difference between the effects of micrometeors and cosmic rays, especially in their penetration power, is discussed. Since data on dust particle impacts are lacking, the effects of micrometeoric erosion were derived on the basis of Opik's meteor crater theory, but it is emphasized that more experimental data are needed. Some of the possible uses of radioactivity for erosion studies are discussed. Qualitative requirements for satellite or space station skin materials are presented. The radiation belts are treated in some detail, and it is stated that they are not safe for manned space stations. Possible methods for avoiding the radiation belts are: operation of satellites below 400 or above 40,000 miles altitude, shielding for the "soft" belt, and sweeping out channels in the belts with satellites of large areas. Criteria for radiation shielding are given taking into consideration the various categories of radiations, range, ionization density, bremsstrahlung, nuclear γ rays, Coulomb excitation, and fragmentation. An optimum shield is presented for the case where γ rays of 0.5 to 5 Mev are absent. (D.L.C.)

3301 SOLAR INFLUENCES ON THE EXTRA-ATMOSPHERIC RADIATION FIELD AND THEIR RADIOBIOLOGICAL IMPLICATIONS. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.) and Abner Golden. p.157-81 of "Physics and Medicine of the Atmosphere and Space." Otis O. Benson, Jr. and Hubertus Strughold, eds. New York, John Wiley & Sons, Inc., 1960.

There is a vast region of space between 200 to 1000 km altitude in which the radiation hazard appears to be tolerable. The radiation field in the lower exosphere, below 1000 km altitude, is treated together with radiobiological and shielding implications. A method is presented for evaluating tissue dosages from air dose data, and the tissue doses at passenger jet plane altitudes (11 km) are briefly discussed. The biological effects of heavy nuclei at the top of the atmosphere are considered with respect to calcium nuclei, and the particular cases of liver and testis being penetrated by calcium nuclei are studied. The effects are expected to be small compared with damage occurring from other causes. Embryonic damage by heavy nuclei is also considered and concluded to be important only in embryos with a high degree of cellular specialization, e.g., the water snail. The effect of the eleven-year solar activity cycles is limited to the low-penetrating components of cosmic radiation, but these components are the main contributors to the biological effect due to their high rate of energy loss. Their spectra are derived for the CNO and Fe groups. The sun as a source of cosmic rays is also considered; it is concluded that much remains unknown regarding solar flares. Radiation fields exist which are caused by the x and β rays in auroral displays, but they are not important as far as shielding is concerned. The electrons and protons in the radiation belt, on the other hand, present shielding problems, necessitating a multilayer shield made from different materials. (D.L.C.)

Criticality Studies

3302 (BAW-1185) LIQUID METAL FUEL REACTOR EXPERIMENT; CRITICAL EXPERIMENT REPORT OF EXPERIMENTAL DATA. T. C. Engelder, H. W. Giesler, J. P. Farrar, and J. H. Mortenson. Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va. Mar. 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 78p. Contract AT(30-1)-1940. OTS.

Results are reported of a series of critical experiments on U^{235}–bismuth–graphite cores, highly reflected by graphite, performed during the course of the Liquid Metal Fuel Reactor Experiment (LMFRE) research and development program. The experiment employs a large movable table assembly on which is erected a graphite honeycomb, with provision for changes in core composition and reflector thickness. Information on the physical arrangement, table and table drive system, control rods and drive system, neutron source and drive, and instrumentation is provided. The critical dimensions of 12 assemblies of pseudocylindrical geometry are reported. These assemblies cover the range of parameters N_{25}/N_{Bi} = 600 to 1200 ppm, V_{Bi}/V_G = 0 and 0.5, and side and end reflectors from zero to 42 in. of graphite. Various small reactivity corrections, such as temperature, residual table gap, room reflections, rod guides and voids, and heterogeneities, were also measured. Extensive microscopic and macroscopic flux measurements were made using bare and

cadmium-covered U^{235}, gold, and Dy–Al alloy foils and wires. The intracell flux distribution in three representative assemblies was measured, and flux ratios were computed for thermal-utilization calculations. Gross-flux traverses were made radially, axially, and diagonally, and over-all contour diagrams were plotted to obtain additional data on flux separability with which to check calculational methods. The important foil-correction factors were studied experimentally so that accurate flux shapes in two-region reactors could be reported. Subcadmium and epicadmium fission distributions were measured, and the radial fuel importance was studied in one assembly. Critical buckling measurements were limited by the small asymptotic region in the reflected assemblies, but sufficient information was obtained to determine the axial and radial reflector savings for N_{25}/N_{Bi} = 1200 ppm. It was also possible to construct two bare or near-bare assemblies, for which the critical buckling is reported. (auth)

3303 (HW-66266) HAZARDS SUMMARY REPORT FOR THE HANFORD PLUTONIUM CRITICAL MASS LABORATORY. W. A. Reardon, E. D. Clayton, C. L. Brown, R. H. Masterson, T. J. Powell, C. R. Richey, R. B. Smith, and J. W. Healy. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Aug. 1, 1960. 122p. Contract AT(45-1)-1350. OTS.

Critical-mass data are needed for plutonium solutions and precipitates of plutonium in order to provide an improved basis of nuclear safety for radiochemical methods of processing plutonium from reactor fuels. The hazards evaluation for critical experiments with plutonium solutions are covered. An outline of the planned experimental program is presented along with the administration of nuclear safety in the laboratory operation. The facility is described in detail together with the proposed experimental equipment and techniques which are to be used for the initial series of critical experiments, but which apply in general to the critical experiments with plutonium solutions. The various functions of the control and interlock systems are examined in detail. The hazards associated with abnormal operations are analyzed in detail. A maximum credible accident is hypothesized, and the consequences are analyzed in detail. (W.L.H.)

Elementary Particles and Radiations

3304 (AD-238064) ON THE CONSISTENCY OF THE PHOTON–ELECTRON SYSTEM–II. Reese T. Prosser. Massachusetts Inst. of Tech., Cambridge. Lincoln Lab. June 6, 1960. 33p. Contract AF19(604)-5200.

A method for establishing the existence of solutions of the field equations of the photon-electron system is applied to the field equations of a coupled Boson-Fermion system with no external sources; the method is then specialized to the photon-electron system. The field equations admit solutions in a well-defined sense, with the well-known renormalized perturbation series as a good asymptotic approximation. Both the general case and a restricted form of the coupled system in which no anti-Fermion phenomena appear are treated. (W.D.M.)

3305 (AERE-R-3354) RESONANCE TRANSMISSION ANALYSIS FOR S-WAVE NEUTRONS. II. TABLES OF AREA FUNCTIONS FOR DOPPLER-BROADENED RESONANCES. J. E. Lynn. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. June 1960. 44p.

Tables of area functions are presented for use in the analysis of S-wave neutron transmission data. The tables allow for appreciable Doppler-broadening of the resonance cross section and for interference between resonance and potential scattering. (For part I see AERE-R-3353.) (C.J.G.)

3306 (ANL-6121) THE SCATTERING OF POSITRONS BY ATOMIC HYDROGEN: FORMULATION. W. J. Cody and Kenneth Smith. Argonne National Lab., Ill. Oct. 1960. 17p. Contract W-31-109-eng-38. OTS.

The derivation of the coupled systems of second-order integrodifferential equations which must be solved numerically in order to obtain the cross sections for the elastic and inelastic scattering of positrons by atomic hydrogen and the cross sections for the formation of positronium into the 1s and 2s states is considered. The numerical method to be used to solve the equations at incident energies above excitation thresholds is also discussed. (auth)

3307 (ANL-6226) MULTIGROUP DIFFUSION THEORY FORMULATION OF THE CALCULATION OF THE MEAN SQUARE SLOWING DOWN DISTANCE IN AN INFINITE MEDIUM. B. J. Toppel. Argonne National Lab., Ill. Oct. 1960. 13p. Contract W-31-109-eng-38. OTS.

Simple expressions for the mean square distance from a point fission source for slowing down past a given energy and for the mean square distance of neutrons that belong to a given energy group are derived within the framework of multigroup diffusion theory. The expressions may be applied to systems having arbitrary group transfer cross sections. (auth)

3308 (CEA-1530) ÉTUDE DE LA DIFFUSION INELASTIQUE DE PARTICULES α A MOYENNE ÉNERGIE. (The Inelastic Scattering of Medium Energy α Particles). Monique Crut. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 58p.

Thesis submitted to Univ. of Paris.

A study was made of the properties of the so-called anomalous states in medium-weight nuclei. These states preferentially excited in the inelastic scattering of medium energy charged particles have an excitation energy of about 4 Mev for nuclei with $Z \leq 29$ and in the range 2 to 3 Mev for high-Z nuclei. From a combination of angular-distribution data in the elastic and inelastic scattering of 30 Mev α particles and correlation data between inelastic α particles and de-excitation γ rays, for even even nuclei one can attribute spin 3 and parity minus to these anomalous states. This is quite in agreement with the interpretation of these levels suggested by Lane as due to collective octupole oscillations. A résumé of the theories used in the analysis of the data and a description of the experimental set-up are given. (auth)

3309 (CEA-1597) MESURES DE LA PRODUCTION DES MESONS K^+ PAR DES PROTONS DANS LES NOYAUX. (Measurement of the Production of K^+ Mesons by Protons in Nuclei). Jacques Teiger. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 59p.

Thesis submitted to Univ. of Caen, France.

K^+ mesons produced by the internal proton beam of Saturne have been identified by means of scintillation and Cherenkov counters. The production cross sections are given per target nucleus measured at a laboratory angle of 35° as well as the cross section relative to π^+ of the same momentum for incident protons of kinetic energy between 1.3 and 2.8 Bev, targets of C, Cu and Pb, and K^+ produced

with kinetic energies between 0.45 and 0.65 Bev. From these results the importance of indirect production by intermediate π mesons with respect to direct production by proton-nucleon collisions is deduced. (auth)

3310 (GAMD-1013) INCURRENT ON A BLACK BODY. J. Devooght. General Atomic Div., General Dynamics Corp., San Diego, Calif. Sept. 28, 1959. 27p. Project No. 32. Contract AT(04-3)-314. OTS.

Methods for calculation of the incurrent were investigated by the use of integral transport theory and various approximations to it. The considerations are limited to the case of a completely black nonscattering body in a scattering and capturing infinite medium with the understanding that all the neutrons hitting the body are absorbed. Results for the various expressions are given. (J.R.D.)

3311 (NP-9294(Vols.I and II)) STRANGE PARTICLE DECAYS AND THE NATURE OF WEAK INTERACTIONS. Physics Department Technical Report No. 193. Jogesh C. Pati. Maryland. Univ., College Park. Sept. 1960. 298p. Contract AF49(638)-24.

These volumes may be further identified as AFOSR-TN-60-1051a(Vol.I) and AFOSR-TN-60-1051b(Vol.II), respectively.

An attempt is made to provide a natural explanation of the approximate validity of the $|\Delta I| = \frac{1}{2}$ rule as well as the slowness of the leptonic modes of the strange particle decays compared to the nonleptonic ones. The Gell-Mann-Dellaporta tetrahedron scheme is adapted. It is shown that for $\Lambda \rightarrow N + \pi$ decays a new set of diagrams satisfying the strict $|\Delta I| = \frac{1}{2}$ rule is much more important than the "usually" considered diagram, which contains an appreciable amount of $|\Delta I| = \frac{3}{2}$ transitions in addition to $|\Delta I| = \frac{1}{2}$ ones. The relative rates of the various K^+ and $K^0_{1,2}$ decay modes are estimated and the mechanism of Λ decay is developed both by perturbation theory and by approximate form factor calculations. The possibility that the four fermion interactions may be mediated by a charged vector boson is examined. (W.D.M.)

3312 (SIT-P-3) QUASI-CLASSICAL THEORY OF THE SPINNING ELECTRON. Ralph Schiller. Stevens Inst. of Tech., Hoboken, N. J. Apr. 1960. 22p. Nonr-263(30). (AD-236676).

A generalized Hamilton-Jacobi theory for a classical spinning dipole is derived and it is shown that this classical theory can be put in a form almost identical with the Pauli spin theory. The theory is quantized by requiring that a classical wave function be continuous and singlevalued and that it satisfy the usual energy eigenvalue equation. In this manner the correct energy levels for a hydrogen atom in an external field are derived. The kernel is derived for the Pauli equation from this classical model, and the kernel for the quasi-classical equation was found. (auth)

3313 (TID-6717) COULOMB SCATTERING OF POLARIZED ELECTRONS. W. R. Johnson, T. A. Weber, and C. J. Mullin. University of Notre Dame, Notre Dame, Ind. [1960]. 27p. OTS.

An approximate analytical expression for the spin dependent cross section for Coulomb scattering, valid to order $(\alpha Z)^4$, is developed. The development is based on a modification of the Sommerfeld-Maue wave function. The $(\alpha Z)^2$ and $(\alpha Z)^3$ terms in the resulting cross section are identical with the corresponding terms found by the second Born approximation. The $(\alpha Z)^4$ term is verified by analytically summing the corresponding term in the Mott series. Graphs are presented which compare the approximate analytical expressions for both the cross section and asymmetry function with exact numerical results. (auth)

3314 (UCRL-6104-T) ON NEUTRAL SPIN-0 PARTICLES WITH IMAGINARY PARITY. Richard Spitzer. California. Univ., Livermore. Lawrence Radiation Lab. Sept. 1960. 11p. Contract W-7405-eng-48. OTS.

Some consequences of the existence of a neutral spin-0 particle with imaginary parity are examined. The particle is subsequently identified with K^0 and it is shown that associated production is a consequence of a superselection law for parity. The parity of the K^0 is fixed by its electromagnetic interaction, which leads to certain results that differ from those predicted by strangeness. The theory accounts directly for the nonconservation of parity in nonneutrino decays of Λ, Σ, and K. (auth)

3315 (UCRL-9028) POSSIBLE MANIFESTATIONS OF A PION-PION INTERACTION. Geoffrey F. Chew. California. Univ., Berkeley. Lawrence Radiation Lab. Jan. 6, 1960. 10p. Contract W-7405-eng-48. OTS.

Various experiments to verify the existence of a P-wave resonance in the π-π system are proposed. Topics discussed in some detail include nucleon electromagnetic structure, electromagnetic π-π production, a three-pion resonance or bound state, and peripheral collisions. (W.D.M.)

3316 (AEC-tr-4191) SOME APPLICATIONS OF THE VARIATIONAL METHOD FOR THE NEUTRON THERMALIZATION PROBLEMS. A. Shimizu. Translated from J. Atomic Energy Soc. Japan 1, 376-84(1959). 21p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 8009.

3317 (CNTr-7) ANALISI FENOMENOLOGICA DELLA FOTOPRODUZIONE DEI MESONI π^0. (Phenomenological Analysis of Photoproduction of π^0-Mesons). K. Dietz, G. Höhler, and A. Müllensiefen. Munich. Technische Hochscule. Institut für Theoretische Physik. [nd]. Translated into Italian.

It has recently been found that experimental data on pion photoproduction at 240 mev are not compatible with the scattering theory of Chew, Goldberger, Low, and Nambu. This disagreement is investigated by first of all determining the real part of the amplitude E_{0+}, M_{1+}, M_{1-}, with a phenomenological analysis of the experimental data. (T.R.H.)

3318 (UCRL-Trans-566) INTERACTION CROSS SECTIONS OF PARTICLES AT HIGH ENERGIES. V. S. Barashenkov. Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics. 1960. Translated by Richard B. Mudge. 56p. JCL or LC.

Interaction cross sections are compiled for interactions of nucleons with antinucleons mesons (π), and mesons (K) and of mesons (π) with mesons (π) and (K) above 0.8 Bev. 89 references. (C.J.G.)

3319 MESON-FERMION PV-INTERACTION IN THE THIRRING MODEL II. G. Pócsik (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung. 12, 55-65(1960). (In English)

The Thirring model completed by a meson-fermion PV coupling is discussed from the point of view of renormalization. It is shown that in the perturbative approach the S matrix contains unrenormalizable divergences coming from the PV part. For the renormalization of the PV part the (neutrino-like) n-fermion m-meson Green's functions of the PS(PV) theory are examined in a nonperturbative approach. The propagators can be made finite by Z_2 re-

normalization. After having calculated the exact Green's functions it is easily seen that just as in the S(V) theory there are no physical effects. The results, which are exact in one dimension, have only approximate validity in the real four-dimensional case. The approximation means omission of all the closed vacuum loops. (auth)

3320 PHASE SHIFTS OF HIGH-ENERGY DIRAC AND KLEIN–GORDON PARTICLES. T. Tietz (Univ., Łódz, Poland). Acta Phys. Acad. Sci. Hung. 12, 85-8(1960). (In English)

The phase shifts of high-energy Dirac and Klein-Gordon particles are calculated by a simple method. It is assumed that the incident particle is extremely relativistic so that the energy E of the incident particle is greater than the mass m of the Dirac or Klein-Gordon particle. (J.S.R.)

3321 INVESTIGATIONS ON THE GENERALIZED ALBEDO PROBLEM. M. Richter (Kernphysikalisches Institut, Deutsche Akademie der Wissenschaften, Zeuthen, Ger.). Ann. Physik (7) 6, 221-6(1960). (In German)

Investigations with a 500-mc radium–beryllium neutron source in a paraffin arrangement were made to obtain information on the accuracy of theoretical considerations on the generalized albedo problem. The measurement of the neutron field was made with dysprosium probes. From the measurement results the usefulness of the theory is shown, and its application in other diffusion problems is completely justified. (tr-auth)

3322 THE DENSITY PATTERN OF THERMAL NEUTRONS IN THE VICINITY OF THE BOUNDARY OF A SCATTERING MEDIUM. M. Richter (Kernphysikalisches Institut, Deutsche Akademie der Wissenschaften, Zeuthen, Ger.). Ann. Physik (7) 6, 227-32(1960). (In German)

The density pattern of thermal neutrons at the boundary of a hydrogen-rich moderator was measured. To obtain the necessary accuracy the reactor in Rossendorf at Dresden was used as neutron source. The results confirmed that the exact theory in this problem is essentially more accurate than the linear Fermi diffusion representation. From the measurements a statement on the degree of anisotropy can be made with some probability. (tr-auth)

3323 BEAMS OF HIGH-ENERGY GAMMA RAYS. V. S. Barashenkov and Ting-Chang Hsien. Atomnaya Energ. 9, 300-1(1960) Oct. (In Russian)

Statistical calculations showed that the number of γ quanta generated per nucleon–nucleon interaction is equal to the number of charged π^0 mesons produced during the event. It is also shown that the intensity of the γ beam is very high. The experimental value of the $W_\pi(p;\theta)$ function (where p is the pulse, θ is the angle of γ emission in laboratory coordinates) for the Dubna synchrophasotron is not known, hence, this function is calculated according to statistical theory of multiple particle production (kinetic energy of accelerated protons E = 10 bev). The calculated spectrum and angular distribution of γ quanta, integrated for all angles of $W_\gamma = W_\gamma(k)$, are plotted. The results indicate that the main γ radiation concentrates in the small angle region. The intensity of radiation rapidly diminishes with the increase of γ energy. The γ radiation also rapidly diminishes with $k \to 0$. (R.V.J.)

3324 ATTENUATION FUNCTIONS FOR WATER EXPOSED TO ISOTROPIC AND HIGHLY COLLIMATED SOURCES OF FISSION NEUTRONS. V. A. Dulin, Yu. A. Kazanskiĭ, V. P. Mashkovich, E. A. Panov, and S. G. Tsypin. Atomnaya Energ. 9, 315-17(1960) Oct. (In Russian)

The spatial distribution of fission neutrons in water was studied using the BR-5 reactor as a neutron source. The neutrons, after passing through a 250-mm beam hole in the concrete shield, passed into a 137 × 139 × 217 cm container of distilled water. The neutron beam enters at the middle of the 137 × 139 cm wall at ~5°. Portable proportional counters fixed in the container along the horizontal and vertical direction were used for neutron detection. The geometry of the experiment and the neutron distributions recorded at various distances are plotted. The attenuation function of (a) isotropic point source neutrons multiplied by r^2 and the attenuation function (b) for a plane collimated source are also plotted. The maximum order of error for (a) appears with small r, (with r = 40 cm it reaches ~20%); a minimum error of 5% was observed with large r. The order of error for (b) varies from ~5% for r = 40 cm up to ~20% for r = 140 cm. The neutron attenuation for a 71.2 cm disc-shaped source is plotted and the obtained curve correlated with the previously derived curve for (b). Correlations of these curves for r > 40 cm indicate a maximum divergence. (R.V.J.)

3325 ENERGY DISTRIBUTION IN WATER FOR FAST FISSION NEUTRONS. V. A. Dulin, V. P. Mashkovich, E. A. Panov, and S. G. Tsypin. Atomnaya Energ. 9, 318-19(1960) Oct. (In Russian)

The energy distribution of fission neutrons in water was studied using the BR-5 reactor as a neutron source. Disc-shaped threshold indicators were used as fast neutron detectors. The characteristics of the threshold indicators are tabulated according to increasing threshold energy for reactions $P^{31}(n,p)Si^{31}$, $T_{1/2}$ = 155 min, energy threshold ~1.5 Mev; $S^{32}(n,p)P^{32}$, $T_{1/2}$ = 14.3 days, energy threshold ~1.5 Mev; $Al^{27}(n,p)Mg^{27}$, $T_{1/2}$ = 9.8 min, threshold energy ~2.1 Mev; and $Al^{27}(n,\alpha)Na^{24}$, $T_{1/2}$ = 15 hr, threshold energy ~6.0 Mev. The threshold indicators were distributed in water at various angles θ to the direction of the incoming neutron beam and at various distances h perpendicular to the beam. The activity of the indicators as a function of θ for r = 30 cm is normalized at θ = 9°, and the activity as a function of h for r = 30 and 60 cm is normalized at h = 0. The energy distributions from a point source in water at 30 and 60 cm are also plotted. (R.V.J.)

3326 A SIMPLE METHOD FOR THE CALCULATION OF THE FERMI AGE OF LIGHT WATER. N. Papmehl (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). Atomkernenergie 5, 357-60 (1960) Oct. (In German)

In calculations performed so far of the Fermi age of H_2O, the starting point was always the energy-dependent transport equation. Instead, it is possible to subdivide the examined lethargy range in a suitable way, and to solve the monoenergetic Boltzmann equation for each of the intervals. This procedure corresponds to a summarizing of neutrons of different energies into "groups," which is often done in the diffusion approximation. The application of this procedure to the calculation of the Fermi age of H_2O leads to a value of τ = 25.0 cm^2, which is in very good agreement with the theoretical value of τ = 25.3 cm^2 obtained again and again by other methods. The analysis of the assumptions made in this calculation shows that the above value might be very low. Refined considerations should therefore prove whether a better agreement with the experimental value (τ = 30.8 cm^2) of the Fermi age of light water can be obtained. (auth)

3327 STUDY OF THE LIFETIME OF POSITRONS IN METALS. Nicole Longequeue (Centre d'Études Nucléaires,

Grenoble, France). Compt. rend. 251, 1376-8(1960) Oct. 3. (In French)

The time distribution of annihilation radiation caused by the absorption of positrons in solids was studied by a coincidence method. Two mean lifetimes of positrons in metals were found, a short one ($1/\lambda_1 \simeq 10^{-10}$ sec) and a long one ($1/\lambda_2 \simeq 7 \times 10^{-10}$ sec). (tr-auth)

3328 CALCULATION OF THE GROUND STATE OF THE DEUTERON WITH SPHERICAL SYMMETRY. Claude Deutsch. Compt. rend. 251, 1459-61(1960) Oct. 10. (In French)

A phenomenological theory of the deuteron based uniquely on the exchange of a meson (π^-) between the proton and the neutron was established. The gound state with spherical symmetry was calculated with the nonrelativistic approximation. By neglecting the tensor forces, the value -2.17 ± 0.108 Mev was found. An exponential charge distribution confirmed by electron diffraction was found by adjusting the structure factor with $k = 8.25$. A "hard-core" neutron-proton potential repulsive at very short distances was determined. (tr-auth)

3329 DEPOLARIZATION OF μ^- MESONS IN NIKFI EMULSIONS PLACED IN A MAGNETIC FIELD OF 10^4 Oe. Ileana Adreescu, Tatiana Angelescu, Calin Besliu, Virginia Coditã, Nicolae Martalogu, Victoria Pîrvu, and Nicolae Gheordănescu (Universitatea, Bucharest). Compt. rend. 251, 1496-8(1960) Oct. 10. (In French)

The depolarization coefficients of the μ^- meson was measured with the aid of two nuclear emulsions under the effect of two magnetic fields. One field of 150 Oe is capable of negating the parasitic effects, and the other of 10^4 Oe is intended to break one of the magnetic couplings and to revive partially the polarization of the μ^- meson. Therefore, the angular distribution of electrons from the disintegration $\mu^- \rightarrow e^- + \nu + \bar{\nu}$ in nuclear emulsions was studied. The comparison of the values obtained with those previously reported led to the conclusion that in the absence of magnetic fields the depolarization of μ^- mesons is almost complete. In a magnetic field of 10^4 Oe a residual polarization of 38% is found which indicates the destruction of one of the magnetic couplings. (J.S.R.)

3330 RELATIVISTIC CALCULATION OF THE GROUND STATE OF THE DEUTERON. Claude Deutsch. Compt. rend. 251, 1609-11(1960) Oct. 17. (In French)

The phenomenological calculation of the deuteron established previously is generalized. The nucleons are considered as recoilless point sources of the mesic field. An invariant theory is obtained by charge conjugation. The charge independence of nuclear forces is deduced. The complex field is reduced into two neutral scalar fields. It is seen that the Yukawa potential has a physical sense only from the relativistic viewpoint. The proton-neutron interaction constant is given by $g^2/4\pi = e^2$. (tr-auth)

3331 ALGEBRAIC CLASSIFICATION OF ELEMENTARY PARTICLES AND INTERACTIONS. Jean-Marie Souriau (Faculté des Sciences, Marseille). Compt. rend. 251, 1612-14(1960) Oct. 17. (In French)

From a three-dimensional "endo-space" (space of neutral mesons), spaces permitting the description of all elementary particles (apart from their spatio-temporal properties) were constructed by three successive spinor extensions. With these three extensions, three types of interaction and three conservation laws are connected; a new selection rule is verified by experiment. (tr-auth)

3332 RELATIONSHIPS IN PROTON-PROTON SCATTERING BETWEEN EXPERIMENTAL QUANTITIES AND THE COEFFICIENTS OF THE DE WOLFENSTEIN MATRIX. Michel Lacombe. Compt. rend. 251, 1768-70(1960) Oct. 24. (In French)

In the case of the elastic scattering of a beam of polarized protons on a target of polarized proton, the expressions for the cross sections and the correlation functions are given by means of the coefficients of the matrix M of scattering. The relationships between M and various observable quantities are recalled for the case when the target is not polarized. (tr-auth)

3333 INTERNAL BREMSSTRAHLUNG OF $\mu^\pm$ MESON. S. A. Gadzhiev and A. I. Mukhtarov (Kirov Azerbaidzhan State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 195-7(1960). (In Russian)

It has been postulated that V-A variations are dominating in $\mu \rightarrow e + \nu + \bar{\nu} + \gamma$ decay. However, Gell-Mann and Rosenfeld indicated that due to the electromagnetic effect other variations are also possible. An attempt is made to investigate $\mu \rightarrow e + \nu + \bar{\nu} + \gamma$ decay from the standpoint of nonconservation of parity and to establish the dynamic forbiddingness of S, P, and T. (R.V.J.)

3334 ELECTROMAGNETIC INTERACTIONS OF DIFFUSE NON-RELATIVISTIC PARTICLES. A. M. Kol'chuzhkin and N. N. Kolesnikov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 4, 87-97(1960). (In Russian)

The cross section of one diffuse particle scattering on another was calculated in nonrelativistic born approximation, considering the charge and magnetic moment of both particles. Accurate nonrelativistic phase formulas for diffuse charges were derived by a variable Schwinger method. (tr-auth)

3335 MESON CHARGE CONSERVATION. V. V. Lebedev (Moscow Inst. of Petroleum-Chemical and Gas Industry). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 4, 135-8(1960). (In Russian)

A formalism is developed generalizing the ordinary Dirac formalism and introducing meson charges with variable sign in transitions to charge-conjugated functions. The formalism permits a prediction of particle properties. (tr-auth)

3336 ON APPLICATION OF CONTINUOUS INTEGRALS ALONG TRAJECTORIES IN THE NON-RELATIVISTIC PARTICLE GREEN'S FUNCTION THEORY. L. Ya. Kobelev (Urals State Univ., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 4, 206-16(1960). (In Russian)

The retarding Green's functions (including the temperature functions) for nonrelativistic interacting particles are described by continuous integrals along functional space trajectories $\xi(\tau)$ with the elements determined by Green's functions for noninteracting particles. The mathematical apparatus for integration in functional space was used for calculating the temperature and nontemperature Green's functions. The derived series for continuous integration expansion into a constant interaction series coincides with previously derived series. It was found that with the assigned function $D_{\mu\nu}$ the series for Green's functions of arbitrary order, which expresses the solution for corresponding equations with functional derivatives, can be condensed into an expression for continuous integration along the trajectories. The utilization of Green's functions for nonrelativistic particles instead of more complex computations using electronic computers is advantageous. (tr-auth)

3337 THE C AND P INVARIANCES OF A FERMION. K. H. Tzou (Institut Henri-Poincaré, Paris). J. phys. radium 21, 674-5(1960) Aug.-Sept. (In French)

In an article on the CP invariances of fields and their interactions, Soloviev (Nuclear Physics 6, 618(1958)) examined a lagrangian of the fermion field which is invariant by the combined CP invariance but is not invariant for C and P separately. It is shown in the present study that this is not actually true if the corresponding transformations of the field operators are well-defined. (J.S.R.)

3338 UNITARITY CONDITIONS FOR BINARY PROCESSES INVOLVING PARTICLES OF ARBITRARY SPIN. A. J. MacFarlane (Imperial Coll., London). Nuclear Phys. 18, 570-4(1960) Sept. (2). (In English)

Using the helicity description of two-particle eigenstates of total angular momentum, it was found that a concise statement can be obtained of the unitarity condition, in the two-particle approximation, for processes of type A + B → C + D involving particles of arbitrary spin. As an illustration of the use of this statement, a specific set of processes is discussed and some remarks are made about its application below the physical threshold. (auth)

3339 A METHOD FOR CALCULATING SCATTERING PHASE SHIFTS. J. N. Lyness (Univ. of New South Wales, Kensington). Nuclear Phys. 18, 654-68(1960) Sept. (2). (In English)

A method based on perturbation theory is derived for obtaining the reflection coefficient for scattering a plane wave by a potential well of a particular type. This type is an extension of a simple potential well where the reflection coefficient is known. This method has the advantage that exact limits can be placed on the possible error due to using the perturbation expansion. A possible application is the exact determination of the effect on the cross section of a "tail" added to a potential well. (auth)

3340 AN EQUIVALENCE THEOREM FOR PARTIALLY GAUGE-INVARIANT VECTOR MESON INTERACTIONS. Abdus Salam (Imperial Coll. of Science and Tech., London). Nuclear Phys. 18, 681-90(1960) Sept. (2). (In English)

Consider a massive neutral vector meson U_μ interacting with other spin zero or spin $\frac{1}{2}$ particles ϕ. If the interaction Lagrangian consists of two parts $L_1(\phi, U) + L_2(\phi)$ where $L_1(\phi, U)$ is (together with kinetic energy terms) invariant for the gage transformations $\phi = \exp(iQ\Lambda)\phi'$, $U_\mu = A_\mu - [(1/\kappa)(\partial\Lambda/\partial x_\mu)]$ and L_2 is not gage-invariant, it is shown that the conventional S-matrix T exp $i(\int L_1(\phi, U) + L_2(\phi))$ identically equals T exp $i(\int L_1(\phi, A) + L_2(\phi'))$. Since all Λ-dependent effects are now contained and displayed explicitly in $L_2(\phi')$ it is possible to give a precise discussion of the renormalization problem for vector meson theories. This is because the suspected nonrenormalizability of these theories arises from $\partial\Lambda/\partial x_\mu$ terms in the conventional S-matrix. (auth)

3341 ON SALAM'S EQUIVALENCE THEOREM IN VECTOR MESON THEORY. S. Kamefuchi (Imperial Coll. of Science and Tech., London). Nuclear Phys. 18, 691-6 (1960) Sept. (2). (In English)

A simple proof is given of the equivalence theorem discussed by Salam. Some comments are made on renormalizability of vector meson fields. (auth)

3342 GROUP THEORY OF HARMONIC OSCILLATORS. I. THE COLLECTIVE MODES. V. Bargmann and M. Moshinsky (Princeton Univ., N. J.). Nuclear Phys. 18, 697-712(1960) Sept. (2). (In English)

The classification of states of N particles moving in a harmonic oscillator common potential is treated. The main concern here is the classification scheme that brings out a collective nature of the states. To obtain this collective behavior, advantage is taken of the invariance of the hamiltonian under both ordinary rotations and the unitary group in N dimensions. (auth)

3343 A METHOD FOR THE MEASUREMENT OF LONG SPIN-LATTICE RELAXATION TIMES. M. Santini (Universita, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10) 16, Suppl. No. 2, 232-9(1960). (In English)

This is a description of a method for measuring long spin-lattice relaxation times. It is based on a series of adiabatic fast passages and is particularly convenient in the case of exceptionally long times. (auth)

3344 AZIMUTHAL ASYMMETRY IN HIGH ENERGY INTERACTIONS. D. P. Stern (Univ. of Maryland, College Park). Nuovo cimento (10) 16, Suppl. No. 2, 251-5(1960). (In English)

High-energy meson showers, produced by cosmic-ray particles and detected in nuclear emulsions, may not only possess a definite angular distribution but also be rotationally asymmetric. A method is proposed by which such an asymmetry might be detected. A way of obtaining its extent, if it exists, is also developed. (auth)

3345 IMAGINARY PART OF THE DELBRÜCK SCATTERING AMPLITUDE. W. Zernik (Argonne National Lab., Ill.). Phys. Rev. 120, 549-51(1960) Oct. 15.

A method for computing the imaginary part of the Delbrück scattering amplitude, based on an expression derived by Kessler, was developed and applied for γ-ray energies of 2.62 and 6.14 Mev. The significance of the calculation with regard to available experimental results is discussed and some possible further developments are outlined. (auth)

3346 SEARCH FOR EVIDENCE OF PARITY NONCONSERVATION IN K-He INTERACTIONS. M. M. Block (Duke Univ., Durham, N. C.), E. B. Brucker, R. Gessaroli, T. Kikuchi, C. M. Meltzer, A. Pevsner, P. Schlein, R. Strand, H. O. Cohn, E. M. Harth, J. Leitner, A. Minguzzi-Ranzi, L. Monari, and G. Puppi. Phys. Rev. 120, 570-1 (1960) Oct. 15.

Parity conservation in strong strange-particle producing interactions is not yet experimentally settled. A search is described for evidence of parity nonconservation in K-He interactions. To search for such evidence the expectation value of the pseudoscalar $P_\Lambda \cdot \sigma_\Lambda$ was measured. This quantity is directly obtained from the decay-pion angular distribution in the Λ rest frame. The observed angular distribution is symmetric. An analysis of 485 Λ^0 producing interactions gives $\alpha(P_\Lambda \cdot \sigma_\Lambda) = +0.04 \pm 0.08$. Thus, no evidence was found for parity nonconservation in K-He^4 reactions. (auth)

3347 PROPOSAL FOR MEASURING THE π^0 LIFETIME BY π^0 PRODUCTION IN ELECTRON-ELECTRON OR ELECTRON-POSITRON COLLISIONS. F. E. Low (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 120, 582-3 (1960) Oct. 15.

The cross section for production of π^0 mesons by colliding electrons is calculated in the virtual photon approximation. This cross section is directly proportional to the inverse π^0 lifetime, and the proportionality constant is independent of the strong couplings. For a center-of-mass

energy of 300 Mev and a π^0 mean life of 10^{-18} sec the total cross section is about 10^{-33} cm^2. (auth)

3348 ELECTROPRODUCTION OF PIONS FROM HYDROGEN AND DEUTERIUM. Gerald G. Ohlsen (Stanford Univ., Calif.). Phys. Rev. 120, 584-92(1960) Oct. 15.

The absolute cross section for direct production of pions in electron-proton and in electron-deuteron collisions was measured by the detection of inelastically scattered electrons. Proton data were taken throughout the range of q^2 = 2.6 f^{-2} to q^2 = 10.75 f^{-2}, and center-of-mass energy E = 1100 Mev to E = 1300 Mev. Data analysis was in terms of a neutron magnetic moment distribution. Comparison with available theory yields a neutron rms magnetic moment of 1 f, but better theoretical calculations may change this value somewhat. No theory for the electroproduction of pions from deuterons exists at present. The deuteron data are presented in terms of absolute cross sections as well as in terms of a deuteron-proton cross-section ratio. (auth)

3349 SEARCH FOR A SECOND π^0. W. Selove and M. Gettner (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 120, 593-8(1960) Oct. 15.

The energy distribution of neutrons from the charge exchange reaction $\pi^- + p \rightarrow \pi^0 + n$ was studied, for π^- mesons stopped in liquid hydrogen, to investigate the possible existence of a second π^0 with mass within a few Mev of the mass of the "ordinary" π^0. No neutron group corresponding to such a second π^0 was seen. The sensitivity of the measurement was such that a second group of relative intensity above 10 to 20% would have been seen for any second π^0 with a mass in the range between about $\frac{3}{4}$ Mev and 2 Mev away from the mass of the ordinary π^0. The data give a lower limit to the π^0 lifetime: $\tau > \sim 5 \times 10^{-21}$ sec. (auth)

3350 PION PRODUCTION FROM $\pi^- - p$ COLLISIONS IN THE LONG-RANGE INTERACTION MODEL. Freda Salzman and George Salzman (European Organization for Nuclear Research, Geneva and Univ. of Colorado, Boulder). Phys. Rev. 120, 599-608(1960) Oct. 15.

Long-range interactions of negative pions with protons resulting in single and double pion production are examined in terms of a meson field theory model in which it is assumed that there is a pion-pion interaction and that the single virtual pion exchange graphs are dominant in large-impact-parameter collisions. This pion exchange leads, in single pion production, to an "excited state," π^*, which "decays" into two pions, and, in double pion production, also to an "excited state," N*, which "decays" into a pion and a nucleon. For sufficiently high relative energy of the incident π^- and proton, each of these processes can occur for small values of the invariant square of the virtual pion four-momentum, Δ^2, in which case the virtual pion carries very little transverse three-momentum. For small Δ^2 it is shown that it is reasonable to neglect final state interactions between the "decay products" of the π^* and those of the N*. It is found that in the limit $\Delta^2 \rightarrow -\mu^2$, where μ is the pion rest mass, the virtual pion behaves kinematically, in the π^* barycentric system, as an incoming pion which scatters elastically with the incident π^-, and also behaves, in the N* barycentric system, as an incoming pion which scatters elastically with the incident proton. Thus, for small Δ^2 in the physical region the π^* and N* vertices are defined as the corresponding off-the-mass-shell scattering amplitudes. A ratio of appropriately defined double-to-single pion production cross sections is obtained which is independent of the details of the assumed pion-pion interaction, and depends only on the relative strengths of N* and N formation. This ratio is estimated by means of the p-wave static nucleon model, applied in appropriate coordinate systems. For incident 5-bev/c pions this model leads to double pion production which is important compared to single pion production, both because of the $\frac{3}{2}-\frac{3}{2}$ pion-nucleon resonance and because of important phase-space factors. Kinematical considerations similar to those described above suggest that this model may also be the theoretical genesis of the "two fireballs" model proposed for ultrarelativistic nucleon-nucleon collisions. (auth)

3351 VACUUM POLARIZATION EFFECTS ON ENERGY LEVELS IN $\mu-$MESONIC ATOMS. Roy Glauber (Harvard Univ., Cambridge, Mass.), William Rarita, and Philip Schwed. Phys. Rev. 120, 609-13(1960) Oct. 15.

The shifts of the energy levels of μ-mesonic atoms due to vacuum polarization are calculated for the states $n = l + 1$. The first-order perturbation integrals are evaluated both in closed form and by means of series expansions. A more accurate calculation of the energy shifts which takes into account the alteration of the atomic wave functions by the vacuum polarization potential is described in the concluding section. (auth)

3352 PHOTOPRODUCTION OF NEGATIVE MESONS IN DEUTERIUM. D. H. White, R. M. Schectman, and B. M. Chasan (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 120, 614-21(1960) Oct. 15.

A 24-in. diffusion cloud chamber filled to 14 atm with tritium-free deuterium gas, operating in a magnetic field of 6 kilogauss, was placed in the 1040-Mev "hardened" bremsstrahlung beam of the Cornell synchrotron. A total of 310 events of the type $\gamma + d \rightarrow p + p + \pi^-$ were observed and analyzed. Using the "spectator model," a total cross section was determined for the reaction $\gamma + n \rightarrow p + \pi^-$ from threshold to 1 bev, in good agreement with the results obtained from the measurement of the negative-to-positive pion ratio together with the measured cross section for the reaction $\gamma + p \rightarrow n + \pi^+$. The momentum distribution of the low-energy protons in the laboratory system compares very favorably with the internal momentum distribution of the deuteron as calculated from the Hulthén or Gartenhaus wave functions. The validity of the spectator model for photons above 200 Mev is experimentally justified, as is expected in consideration of the assumptions of the impulse approximation. A study of the forward-backward asymmetry of the spectator protons in the laboratory system indicates that above photon energies of 250 Mev, there is a 15% deviation from isotropy, favoring the forward beam direction, indicating that the spectator proton is being "pulled along" with the net forward momentum of the rest of the system, through an average forward momentum transfer of about 10 Mev/c. (auth)

3353 PROTON-PROTON EFFECTIVE-RANGE THEORY WITH VACUUM POLARIZATION. Leon Heller (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 120, 627-34(1960) Oct. 15.

The effect of vacuum polarization upon p-p scattering is considered by first solving the problem in the Coulomb plus vacuum polarization potentials (called "electric" potential) without the nuclear potential. The nuclear phase shifts are then defined with respect to the electric wave functions, and the scattering cross section is written in terms of these phase shifts. The connection with other nuclear phase shifts (in the presence of vacuum polarization) which appear in the literature is established. The effective-range expansion for the nuclear s-wave phase shift is derived. An analysis of three low-energy p-p scattering experiments indicates that the omission of vacuum polarization from the

analysis results in a value for the shape-dependent parameter which is 0.02 smaller than the value obtained when vacuum polarization is included in the analysis. A discussion of the accuracy required to usefully delimit this parameter is included. (auth)

3354 PION-PION INTERACTION IN ELECTROMAGNETIC PROCESSES. Laurie M. Brown (Università, Rome) and Francesco Calogero. Phys. Rev. 120, 653-8(1960) Oct. 15.

The correction to the photon propagator due to the emission of a virtual pion pair is evaluated considering the effect of the strong pion-pion interaction in the J = 1, T = 1 state of the pions recently discussed by several authors. Results are given for different sets of parameters describing the pion form factor, and the possibility of investigating the structure of the form factor by means of electron-electron and electron-positron collision experiments is studied. (auth)

3355 ANISOTROPIC FERMION GAS. G. Wentzel (Univ. of Chicago). Phys. Rev. 120, 659(1960) Nov. 1.

Kohn and Luttinger pointed out that the usual linked-cluster expansion for the ground-state energy of a many-fermion system is incomplete if there are deviations from spherical symmetry. An energy term for the second order in the interaction was derived as a result of a study of a grand canonical ensemble in the zero temperature limit. This energy term is shown to have a simple geometrical meaning. (B.O.G.)

3356 ASYMMETRY IN THE ELASTIC SCATTERING OF POLARIZED PROTONS BY DEUTERIUM. Stewart M. Marcowitz (Univ. of Chicago). Phys. Rev. 120, 891-900 (1960) Nov. 1.

Asymmetries in the elastic scattering of polarized protons by deuterium were measured at 419 Mev at proton center-of-mass angles from 47.9 to 115°. The inferred polarizations are -0.092 ± 0.058 at 47.9°, -0.502 ± 0.058 at 59°, -0.583 ± 0.081 at 68°, -0.141 ± 0.056 at 77.8°, -0.122 ± 0.111 at 90°, -0.150 ± 0.059 at 97°, -0.309 ± 0.073 at 105°, and $+0.174 \pm 0.059$ at 115°. It is suggested that using the impulse approximation these results may serve as a test of nucleon-nucleon scattering phase shifts or, with proton-proton scattering data, may be used to obtain I = 0 nucleon-nucleon phase shifts. (auth)

3357 MEASUREMENT OF THE GAMMA-RAY SPECTRUM FROM RADIATIVE MUON DECAY. C. O. Kim, W. J. Kernan, and C. M. York (Univ. of Chicago). Phys. Rev. 120, 983-7(1960) Nov. 1.

The energy spectrum of the γ rays emitted by inner bremsstrahlung in the muon decay process, $\mu^+ \rightarrow e^+ + \nu + \bar{\nu} + \gamma$, was measured by means of a large sodium iodide crystal. Only those γ rays which were time-coincident with the decay electrons were recorded. These decay electrons were detected in a scintillation counter telescope adjoining the crystal counter. The counter geometry permitted detection of events with angles between the electron and γ ray in the range from 0 to 26°. The muons were obtained by stopping a positive pion beam in a block of material. By measuring the γ-ray spectra from muons originating first in carbon and then aluminum, a correction could be made for bremsstrahlung externally produced by the decay electrons. The measured spectrum is in agreement with that predicted by the theory with an average ratio of 1.02 ± 0.10. (auth)

3358 ASSOCIATED PRODUCTION IN PROTON-PROTON COLLISIONS. E. Ferrari (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Phys. Rev. 120, 988-92(1960) Nov. 1.

The simplest reactions of associated production in proton-proton collisions are investigated with the aid of two simple models, which consider as relevant only the contribution due to the exchange of one intermediate π meson or K meson, respectively. The values of the total cross sections predicted by these models are calculated at various energies up to 3.5 Bev of the incident proton in the lab system. These cross sections are related to the experimental cross sections for simpler processes, namely associated production by pions (first model) and K^+-nucleon scattering (second model). Both models give the same order of magnitude for the cross sections for all reactions (10^{-2} mb at lower energies, 10^{-1} mb at higher energies), except for Σ^0 production, where the results predicted by the two models differ by a factor of 10. Some of the calculated values are affected by large errors, due to the uncertainty of the experimental data which are used. (auth)

3359 EXPERIMENTAL STUDY OF THE MAGNETIC STRUCTURE OF THE NEUTRON. J. I. Friedman, H. W. Kendall, and P. A. M. Gram (Stanford Univ., Calif.). Phys. Rev. 120, 992-9(1960) Nov. 1.

A measurement of the ratio of the magnetic form factor of the neutron to that of the proton was carried out by comparing large- and small-angle elastic electron-deuteron scattering at constant four-momentum transfers. The experimental result for the average value of the ratio in the range of momentum transfers from 1.6 f^{-1} to 2.25 f^{-1} is $F_{2n}/F_p = (0.91 \pm 0.05) \pm 0.07$; the first error is a standard deviation arising from experimental uncertainties, and the second from theoretical uncertainties in the analysis. Measurements of the ratio of the nucleon isotopic scalar form factors were obtained from this experiment. The average value of F_2^s/F_1^s for the same range of momentum transfers was found to be $(+0.06 \pm 0.09) \pm 0.13$. The small-angle scattering data were used to determine the charge form factor of the deuteron in the range of momentum transfers from 0.98 f^{-1} to 2.8 f^{-1}. The results are consistent with a repulsive-core model of the deuteron. (auth)

3360 DECAY ASYMMETRY OF Σ^+ AND Λ^0 HYPERONS. Bruce Cork (Univ. of California, Berkeley), LeRoy Kerth, W. A. Wenzel, James W. Cronin, and R. L. Cool. Phys. Rev. 120, 1000-4(1960) Nov. 1. (UCRL-9127)

Counter techniques were used to measure decay asymmetries for polarized Λ^0 and Σ^+ hyperons. The Σ^+ hyperons were produced by 1.13-Bev/c π^+ in the reaction $\pi^+ + p \rightarrow \Sigma^+ + K^+$. The Λ^0 hyperons were produced by 1.00-Bev/c π^+ in the reaction $\pi^+ + d \rightarrow K^+ + \Lambda^0 + p$. The asymmetry for each hyperon decay mode was measured with a counter arrangement which detected separately charged pions and γ rays from neutral pions. The protons from the hyperon decay were also detected to confirm the identification of the decay modes. The product $\alpha\bar{P}$ was measured, where α is the asymmetry parameter and $\bar{P}$ is the average polarization of the hyperon. The following results were obtained for the various decay modes: $\Sigma^+ \rightarrow \pi^+ + n$, $\alpha\bar{P} = +0.03 \pm 0.08$; $\Sigma^+ \rightarrow \pi^0 + p$, $\alpha\bar{P} = +0.75 \pm 0.17$; $\Lambda^0 \rightarrow \pi^- + p$, $\alpha\bar{P} = +0.55 \pm 0.06$; and $\Lambda^0 \rightarrow \pi^0 + n$, $\alpha\bar{P} = +0.60 \pm 0.13$. The results for Σ^+ are fitted to the triangular relationship demanded by the $|\Delta I| = \frac{1}{2}$ rule, and absolute values for the asymmetries of $\Sigma^\pm$ decay are predicted. The ratio $\alpha(\Lambda^0 \rightarrow \pi^0 + n)/\alpha(\Lambda^0 \rightarrow \pi^- + p) = +1.10 \pm 0.27$ is in agreement with the value +1.00 predicted by the $|\Delta I| = \frac{1}{2}$ rule for hyperon decay. (auth)

3361 QUASI-ELASTIC PROTON-PROTON SCATTERING AT 158 Mev. B. Gottschalk and K. Strauch

(Harvard Univ., Cambridge, Mass.). Phys. Rev. 120, 1005-12(1960) Nov. 1.

The cross section in impulse approximation for a quasi-elastic proton-proton scattering reaction with a bound target proton depends on the probability of finding inside the nucleus a proton with a momentum equal to the momentum transfer required by kinematics. This momentum transfer is determined if the incident energy and the energies and angles of the two outgoing partners of a proton pair are measured. Events involving s and p protons can be experimentally distinguished by noting that more energy is required to remove an s proton from the nucleus than a p proton. Thus the momentum eigenfunctions of each state can be explored experimentally by varying the momentum transfer, keeping constant the energy sum of a proton pair. Two methods of doing this to bring out the difference between scattering from s and p protons are discussed. They are examination of the distribution of events as a function of the energy sharing between the two outgoing protons, at fixed scattering angles, and examination of the angular distribution of events having fixed sharing. Born approximation calculations are presented for predicting the regions of maximum sensitivity to differences between s and p protons. These predictions are used in the design of two experiments on the reaction $C^{12}(p,2p)B^{11}$; the results are reported. They show good qualitative agreement with the predictions for p protons, namely that the sharing will tend to be unequal if the scattering angle of each proton is near 45° [type (1) experiment] and that the angular distribution of events of equal sharing will have a minimum at 45° [type (2) experiment]. The predicted behavior (opposite to that for p protons) for events involving s protons is not observed, and this fact is discussed in the light of possible inadequacies of the theory or of the experiment. (auth)

3362 RELATIVE IONIZATION OF PROTONS NEAR THE END OF THEIR RANGE. Hans Bichsel (Univ. of Southern California, Los Angeles). Phys. Rev. 120, 1012-14(1960) Nov. 1.

The influence of multiple scattering on straggling and consequently on the ionization produced by protons close to the end of their range is derived. The effect due to nuclear reactions is shown to be small at 340 Mev. The observed data at this energy are satisfactorily accounted for. (auth)

3363 ELASTIC SCATTERING OF 5-BEV π^- MESONS ON HYDROGEN. Richard G. Thomas, Jr. (Univ. of California, Berkeley). Phys. Rev. 120, 1015-20(1960) Nov. 1. (UCRL-8965(Rev.))

The elastic scattering of 5-Bev negative pions on hydrogen was observed in a large propane bubble chamber. It is shown that $\approx(7 \pm 3)\%$ of the events called elastic are probably background. The observed angular distribution is strongly peaked forward. This fact suggests that diffraction scattering is the dominant process at this energy. The theoretical analysis of the distribution is in terms of the optical model. It is shown that the proton acts like a partially opaque sphere of radius 1.04×10^{-13} cm ± 5%. The total elastic cross section is found to be 5.6 ± 0.5 mb. From the extrapolated value of $d\sigma(0)/d\Omega = 29.8$ mb/steradian ± 10% in the center-of-mass system, a value of 29.1 ± 2.9 mb was calculated for the total hydrogen cross section. The opacity of the sphere is thus 0.69 ± 0.05. (auth)

3364 SEARCH FOR S = −2 NEGATIVE HEAVY MESON IN NUCLEAR EMULSIONS. Y. Eisenberg (Weizmann Inst. of Science, Rehovoth, Israel), M. Friedmann, G. Alexander, and D. Kessler. Phys. Rev. 120, 1021-2 (1960) Nov. 1.

A search for the D^- meson was conducted in an emulsion stack exposed to the 300-Mev/c K^- beam at Berkeley. The stars initiated by the beam particles were investigated for possible emission of two strangeness-carrying particles, and in addition mass measurements were done on the short-range tracks. In about 10,000 events examined, no possible S = −2 particle was observed. Hence the upper limit for the D^--meson occurrence in the present experimental conditions is ~1/100 from the double strangeness observation and ~1/6000 from direct mass determinations. (auth)

3365 MULTIPLE MESON PRODUCTION IN NUCLEON-ANTINUCLEON ANNIHILATIONS. LeRoy F. Cook, Jr., and Joseph V. Lepore (Univ. of California, Berkeley). Phys. Rev. 120, 1028-40(1960) Nov. 1. (UCRL-8841(Rev.))

A two-parameter model is proposed for treating complicated production problems in a relatively simple way. It is assumed that the interaction may be characterized by a range of interaction and by a coupling strength. After the model is developed, it is applied to the problem of pion production in $N-\bar{N}$ annihilations. The two parameters are fixed by the experimental data for the multiplicity and energy spectra. It is found that all data can be satisfied if one chooses the radius of interaction to be one pion Compton wavelength. Under certain restrictions the model reduces to the Fermi model. (auth)

3366 DETERMINATION OF THE FORWARD SCATTERING AMPLITUDE FROM THE OPTICAL-MODEL POTENTIAL IN THE HIGH-ENERGY LIMIT. R. Lipperheide and D. S. Saxon (Univ. of California, Los Angeles). Phys. Rev. 120, 1458-9(1960) Nov. 15.

A relation between the two-particle forward scattering amplitude, $f_k(0)$, and the volume integral over the optical potential, $V_k(x)$, is given in the high-energy limit, which is valid at least to second order in the two-body interactions, neglecting correlation and exchange terms. The relation is $\int V_k(x)dx = -(2\pi\hbar^2/m)Af_k(0)$, where A is the number of nucleons in the target, and m is the reduced mass of the two-particle system. The connection between the shape of the optical-model potential and the density distribution of the target nucleus is discussed. (auth)

3367 DEPOLARIZATION DUE TO TARGET MOTION. Albert E. Werbrouck (Princeton Univ., N. J.). Phys. Rev. 120, 1463-7(1960) Nov. 15.

The projection upon both of the lab scattering planes of a spin component along the center-of-mass angular momentum direction was computed for arbitrary target motion. The resulting depolarization of Λ hyperons produced by 1080-Mev/c pions on nuclear matter and on deuterons is presented as a function of production angle. At this energy, the polarization, if constant for all production angles, would be reduced to 85% and 95% of the original value in heavy nuclei with respect to the $\pi \times \Lambda$ and $K \times \Lambda$ planes, respectively. In deuterium, the reductions would be to 98.4% and 99.5% of the initial polarization. (auth)

3368 LOW-ENERGY NEUTRAL PION PHOTOPRODUCTION IN H_2 AND He. A. Odian, G. Stoppini, and T. Yamagata (Univ. of Illinois, Urbana). Phys. Rev. 120, 1468-81(1960) Nov. 15.

The results of an experiment on the photoproduction of neutral pions from hydrogen and helium in the very low-energy region are compared with the dispersion relation calculations of Chew, Goldberger, Low, and Nambu. For hydrogen, agreement was found for incident γ ray energies above 155 Mev for $N^+ \simeq +0.065$ and disagreement below

for all constant values of N^+. The helium results give support to their effective-range formulas for the small p-wave phase shifts. (auth)

3369 LEPTON DECAYS OF HYPERONS. D. R. Harrington (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 120, 1482-5(1960) Nov. 15.

An expression is given for the lepton energy spectrum and asymmetry for the lepton decay modes of hyperons in terms of 6 form factors. A weak interaction having the form of the usual lepton current coupled to an unspecified strong current is assumed, and the momentum transfer dependence of the form factors is neglected. Some applications to the decays $\Lambda \rightarrow p + e + \bar{\nu}$ and $\Lambda \rightarrow p + \mu + \bar{\nu}$ are given. (auth)

3370 PION-NUCLEON SCATTERING IN THE MANDELSTAM REPRESENTATION. S. C. Frautschi (Univ. of California, Berkeley) and J. D. Walecka. Phys. Rev. 120, 1486-1505(1960) Nov. 15.

Using the analytic properties of partial wave scattering amplitudes, as derived from Mandelstam's representation, the $J = 3/2$, P state of the pion-nucleon system was studied. The method used was covariant; it incorporated unitarity. The effect of a possible pion-pion resonance was investigated. Using the "single nucleon term" and the low-energy scattering properties of the "crossed states," a resonance in the $J = 3/2$, $T = 3/2$ pion-nucleon state was obtained without the aid of a cutoff. Also investigated was scattering in the $T = 1/2$ state. The pion-pion resonance appeared to have only a very small effect in the $T = 3/2$ state; whereas, in the $T = 1/2$ state it increased the phase shift by a factor of 2. The resonance obtained in the $T = 3/2$ state occurred at too low an energy. There are several factors which may account for this including the contributions from crossed states, and inelastic scattering. (auth)

3371 PROBLEMS OF PROVING THE MANDELSTAM REPRESENTATION. Richard J. Eden (Univ. of California, Berkeley). Phys. Rev. 120, 1514-18(1960) Nov. 15. (UCRL-9254)

It is shown that sufficiency conditions for the validity of the Mandelstam representation of a collision amplitude can be stated in terms of the location of singularities of its physical branch when one of the energy variables is real and positive and the second independent energy variable is complex. It is also shown that in perturbation theory the real singularities of the physical branch must correspond to positive Feynman parameters provided that none of the curves of singularities identified in this way have turning points in positive spectral regions. The same condition will exclude complex singularities in the physical sheet that are connected to the curves of singularities on its real boundary. If there are any disconnected complex singularities, they must correspond to complex Feynman parameters. It is concluded that sufficiency conditions for the Mandelstam representation are the absence of turning points in positive spectral regions and the absence of disconnected complex singularities in the physical sheet. In the equal-mass case, these conditions are both necessary and sufficient, and real singularities in the physical sheet can be identified by requiring that the Feynman parameters be positive. The conditions are satisfied by ladder diagrams when there are no anomalous thresholds. [It was proved that the representation is correct for every order in perturbation theory. See Phys. Rev. Letters 5, 213 (September 1, 1960), letter by the author. The proof requires some of the results of this paper.] (auth)

3372 PRODUCTION OF POLARIZED NEUTRONS BY REFLECTION FROM COBALT MIRROR. Yu. G. Abov, V. A. Beketov, A. D. Gul'ko, O. N. Ermakov, P. A. Krupchitskiĭ, Yu. V. Taran, and N. S. Shatlovskaya (Inst. of Experimental and Theoretical Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 4, 51-5(1960) July-Aug. (In Russian)

A beam of polarized thermal neutrons was developed by reflection from a magnetized cobalt mirror. The polarization was determined by reflecting the beam from a second cobalt mirror and was equal to (75 ± 2)% at a neutron angle of incidence of 8′. The polarized flux was 2×10^6 neutrons/sec. A 100% polarization was achieved at large incidence angles. The methods for preparing the mirrors, for producing the polarized beams, and for measuring polarization are described. (tr-auth)

3373 THE PROBLEMS OF ELEMENTARY PARTICLES. I. E. Tamm. Priroda 49, No. 8, 9-16(1960) Aug. (In Russian)

The present theory of elementary particles is unsatisfactory because there is no unifying law to explain the some 30 odd independent "elementary" particles. A qualitative discussion is presented on strong, electromagnetic, and weak interactions. A definite nuclear charge is ascribed to the proton, neutron, and hyperon that other particles such as the photon, neutrino, electron, and meson do not possess. One of the main theses of contemporary physics is that each kind of elementary particle has a corresponding antiparticle. The nonconservation of parity in weak interactions (β decay) is discussed, and the theory of Landau on the invariance with respect to the combined inversion is cited. All the particles can be arranged in two groups. One contains particles with a spin of one-half and the other contains particles with an integral spin (including zero). All known particles with a nuclear charge have a larger mass than the corresponding particle without a nuclear charge. Heisenberg's "nonlinear field theory" and other mathematical theories that attempt to explain the physics of elementary particles are discussed in qualitative terms. (TTT)

3374 A NEW ANTI-PARTICLE, THE ANTISIGMA MINUS HYPERON. Ta-Ts'ao Ting and E. N. Kladnitskaya (Joint Inst. of Nuclear Research, Dubna, USSR). Priroda 49, No. 8, 17-18(1960) Aug. (In Russian)

A beam of protons with energies of 10^{10} ev from a synchrophasotron were used to bombard a target and form π^- mesons of high energy. With the help of magnetic lens and focusing magnets a beam of π^- mesons with an energy of 8.3 bev was separated and directed into a propane bubble chamber at a constant magnetic field tension of 13,700 oersteds. On analyzing 40,000 photographs which recorded tens of thousands of other nuclear interactions, proof of the existence of an unstable antiparticle, the antisigma minus hyperon, was found. It decays in 10^{-10} seconds to π^+ and an antineutron. (TTT)

3375 COMPARATIVE MEASUREMENTS WITH INTENSITY STANDARDS FOR ENERGETIC BREMSSTRAHLUNG. J. S. Pruitt and W. Pohlit (National Bureau of Standards, Washington, D. C. and Max-Planck-Institut für Biophysik, Frankfurt am Main). Z. Naturforsch. 15b, 617-19(1960) Sept. (In German)

An aluminum ionization chamber was constructed at the NBS to measure the intensities of bremsstrahlung. The calibration values obtained for it are tabulated. An identical ionization chamber was used at the Max Planck Institut für Biophysik in conjunction with a total-absorbing calorimeter.

The results obtained with the German instrument were compared with those of the NBS. The comparison showed that it is possible to measure absolutely the intensity of energetic bremsstrahlung with a mean error of 1%. The arrangement used for the comparative measurements is shown. (J.S.R.)

3376 THE LINEAR POLARIZATION OF THE ANNIHILATION RADIATION OF POSITRONS. Hansheinrich Langhoff (Universität, Göttingen, Ger.). Z. Physik 160, 186-93(1960). (In German)

A new measurement of the relative linear polarization of the annihilation radiation of positrons is described. The angular resolution of the double polarimeter used was improved in comparison with earlier experiments by the construction of a fast fourfold-coincidence apparatus. Within an experimental error of 1.5%, the results are in full agreement with the complete polarization predicted by pair theory. (auth)

3377 A COMPARATIVE MEASUREMENT OF THE TOTAL EFFECTIVE CROSS SECTIONS OF THE BREMSSTRAHLUNG FROM 14.5-MEV ELECTRONS IN GOLD, TANTALUM, AND SILVER. H. J. Langmann (Universität, Heidelberg, Ger.). Z. Physik 160, 213-18(1960). (In German)

With electrons of 14.7 Mev the comparative cross sections for bremsstrahlung production at the energetic end of the spectrum were studied for gold, tantalum, and silver. The transformation of Cu^{63} and Cu^{62} by the nuclear photoeffect was used for the detection of the bremsstrahlung. No deviations from the theory established by Bethe and Heitler by means of the Born approximation could be found greater than 2% at a measurement error of ±1.5%. (tr-auth)

3378 ON ELECTROMAGNETIC SCATTERING OF SPIN 1/2 PARTICLES. L. G. Moroz (Inst. of Physics, Academy of Sciences, Belorussian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 589-90(1960) Sept. (In Russian)

A general formula was derived for the electromagnetic scattering of two different longitudinally polarized spin ½ particles. (auth)

3379 HIGHER BORN APPROXIMATION IN PAIR CONVERSION. V. A. Krutov and V. G. Gorshkov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. 39, 591-9(1960) Sept. (In Russian)

Higher Born approximations with respect to the nuclear Coulomb field are considered in pair conversion. The integrals which comprise the first approximation can be taken exactly and yield a simple analytic result. (auth)

3380 ON $K^+ \to \pi^+ + e^+ + e^-$ AND $K^+ \to \pi^+ + \mu^+ + \mu^-$ DECAYS. L. B. Okun and A. P. Rudik. Zhur. Eksptl'. i Teoret. Fiz. 39, 600-4(1960) Sept. (In Russian)

Hitherto unobserved $K^+ \to \pi^+ + e^+ + e^-$ and $K^+ \to \pi^+ + \mu^+ + \mu^-$ decays that may be due to combined electromagnetic and weak interactions were examined. The absolute values of the probabilities for these decays are determined by the magnitude of the $K \to \pi^-$ transition monopole moment, which at present cannot be computed. The ratio of the probabilities was calculated and found to be $W_\mu / W_e \approx 0.2$. The π meson, electron, and muon spectra were calculated, and some convenient methods for treatment of the experimental results are indicated. (auth)

3381 WHICH IS THE HEAVIER, THE K_1^0-MESON OR K_2^0-MESON? I. Yu. Kobzarev and L. B. Okun. Zhur. Eksptl'. i Teoret. Fiz. 39, 605-9(1960) Sept. (In Russian)

A method for determining the mass difference of the K_1^0- and K_2^0-mesons is proposed, which not only yields the magnitude of the difference but its sign as well. The method is based on the observation of interference of K_1^0-mesons created in plates of various substances by a K_2^0-meson beam. (auth)

3382 ON THE NUCLEON-NUCLEON POTENTIAL. A. F. Grashin and Yu. P. Nikitin. Zhur. Eksptl'. i Teoret. Fiz. 39, 713-19(1960) Sept.

A convenient method is proposed for setting up the potential in the form of the series $U(x) = \Sigma U^{(n)}(x)$, $U^{(n)}(x) \sim e^{-nx}$ for $x \to \infty$ in terms of the meson-theoretical scattering amplitude expressed as an expansion in the exchange mesons (x is the distance in $1/\mu$ units, where μ is the meson mass). In the case of peripheral nucleon interaction the application of this method yields a two-meson potential with a broad locality region $p^2/m^2 \ll 1$ (nonrelativistic region). The two-meson potential practically consists of tensor and central attractive forces that are weakly dependent on the isotopic state. (auth)

3383 ON THE NORMALIZATION CONSTANTS OF THE STATE VECTORS IN FIELD THEORY. M. A. Braun (Leningrad State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 737-40(1960) Sept.

By aid of weak convergence methods it is shown that the normalization constant of the n-particle state in field theory introduced by Van Hove and De Witt is equal to the product of the so-called vacuum constant and a factor Z^n, where Z is the renormalization constant of the wave function in the conventional field theory formalism. (auth)

3384 ON COVARIANT STATISTICAL THEORIES OF MULTIPLE PARTICLE PRODUCTION. V. M. Maksimenko and I. L. Rozental (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 754-6(1960) Sept.

Possible covariant theories of multiple particle production were analyzed under the condition that the matrix element could be factorized. The multiplicity of the secondary particles was computed by assuming that the matrix element is a power function of the energy of the particles involved in the process. (auth)

3385 RADIATIVE CORRECTIONS TO THE SCATTERING OF μ-MESONS ON ELECTRONS. A. I. Nikishov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 757-66(1960) Sept.

Formulas of the cross sections for the processes $\mu + e^\pm \to \mu + e^\pm$ and $e^+ + e^- \to \mu^+ + \mu^-$ were deduced with an accuracy to e^6. (auth)

3386 RELATION BETWEEN THE MATRICES OF VARIOUS TRANSITIONS AND MULTIPLE PROCESSES. B. T. Vavilov and V. I. Grigor'ev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 794-9(1960) Sept.

An infinite set of chain equations relating the matrices of various transitions is given. Renormalization of the mass was performed. The renormalized set was used to treat multiple creation of bosons in the collision of two fermions. (auth)

3387 THE HYPOTHESIS OF THE NEUTRAL ρ^0-MESON IN THE LIGHT OF DATA ON ANTIPROTON ANNIHILATION. V. I. Gol'danskiĭ and V. M. Maksimenko (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 841-4(1960) Sept.

According to the classification proposed by Gell-Mann and Nishidzima, a neutral ρ^0-meson with zero strangeness should exist. The following decay schemes for this particle were indicated in the literature $\rho^0 \to \pi^+ + \pi^- + \gamma$, $\rho^0 = \pi_0^0 \to$

2γ, $\rho^0 = \pi^0_{10} \rightarrow 3\gamma$. The possible contribution of such decays (for various ρ^0-meson masses) in the annihilation of antiprotons is discussed from the viewpoint of the statistical theory of multiple processes. The data presently available on the yield of π^+, π^-, and π^0 mesons during annihilation are inconsistent with the existence of a π^0_0 meson with a mass smaller than 3.5 m_π and also with the existence of a π^0_{10} meson with a mass smaller than 5.5 m_π. On the other hand the $\rho^0 \rightarrow \pi^+ + \pi^- + \gamma$ decay not only does not contradict the experimental data but even removes some difficulties connected with determining the interaction volume. (auth)

3388 ON THE COEFFICIENT OF SPIN CORRELATION IN p-p SCATTERING AT 310 Mev AT 90° ANGLE IN CENTER MASS SYSTEM. I. M. Vasilevskiĭ, V. V. Vishnyakov, E. Iliesku, and A. A. Tyapkin (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 889-91(1960) Sept.

In addition to the phase analysis made of Berkeley data on elastic interactions of 310 Mev protons, an analysis was made of the spin correlation of scattered 310 Mev protons. The initial analysis included 14 phases related to states including H waves. An additional analysis considered the contribution of states of higher orbital moments based on a single-meson approximation. Calculated in the first approximation by perturbation theory, the higher states contribute only one parameter to the analysis, the pion-nucleon bond constant g^2. A modified analysis shows that only the first and second phase sets describe satisfactorily the experimental data with $g^2 \sim 14$. The magnitudes of the coefficients $C_{nn}(90°)$, corresponding to the new phase magnitudes for the separated sets, becomes 0.38 for the first set and 0.61 for the second. The initial Liverpool and Dubna experiments confirmed the selection of the second set of phases, indicating spin correlation coefficients $C_{nn}(90°) = 0.75 \pm 0.11$ and 0.7 ± 0.3, respectively. The final experiment for determining the analytical ability of scatterers was carried out with 160-Mev proton beams with polarization of 0.667 ± 0.027. The polarization ability of analyzers used for measuring the asymmetry was equal to 0.28 ± 0.02. Considering that the magnitude of the C_{nn} coefficient cannot exceed 1.0, $C_{nn}(90°) = 0.84^{+0.10}_{-0.22}$. Further analysis was made of the phase sets describing elastic p-p scattering at 310 Mev, using modified phase analysis; but use was made of only 9 out of the previously mentioned 14 phases and the pion-nucleon bond constant g^2, which describes both the first and the second phase sets. The value of the $C_{nn}(90°)$ coefficient determined was about 0.41; thus, in order to solve the problem of two phase sets, it is suggested that C_{crit} be measured at 45°, determining correlations between spin components in the ground scattering plane. However, analysis of the 9 phases and g^2 leads to the disappearance of the $C_{nn}(90°)$ difference for the first and second set. Further studies are suggested. (R.V.J.)

Nuclear Properties and Reactions

3389 (AERE-R-3452) ON $\bar{\nu}$, THE AVERAGE NEUTRON YIELD PER FISSION. J. S. Story. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. July 1955. Decl. Aug. 19, 1960. 13p. (NRDC-73). BIS.

A very crude statistical model is applied to see what qualitative predictions can be made about $\bar{\nu}$ as a function of the excitation energy of the fissioning nucleus, and of the mass and charge of the fissioning nucleus. Suggestions are made for further experimental work. If current discrepancies between the theory and experiment are confirmed, it would be necessary to invoke a more specialized model. (auth)

3390 (AFSWC-TR-60-30; AFSWC-TR-60-30(App.II) A STUDY OF NEUTRONS AND GAMMA RAYS FROM NEUTRON INDUCED REACTIONS IN SEVERAL ELEMENTS. [Period covered]: June 1, 1959 to June 30, 1960. J. T. Prud'homme, I. L. Morgan, J. H. McCrary, J. B. Ashe, and O. M. Hudson, Jr. Texas Nuclear Corp., Austin, Tex. June 1960. 74p. Appendix II. 132p. Contract AF(601)-1967.

These two reports were issued separately, but are cataloged as a unit.

An extensive literature survey was conducted to determine the angular and energy distribution of neutrons nonelastically scattered at 1 and 15 Mev from a number of elements and to determine information concerning γ rays from such events. Where sufficient or accurate information was lacking in the literature, experimental measurements of these quantities were made. (W.D.M.)

3391 (BNL-634) NEUTRON CROSS SECTION EVALUATION GROUP NEWSLETTER NO. 2, OCTOBER 1960. Sophie Moore, Charles Porter, and Rudolph Sher. Brookhaven National Lab., Upton, N. Y. 10p. OTS.

This newsletter appears from time to time in order to acquaint users of neutron-cross-section data with recent information received by the Brookhaven National Laboratory Cross Section Evaluation Center. Angular distributions, thermal cross sections, fast cross sections, neutron resonance parameters, and (n,p) reaction cross sections are given. (W.D.M.)

3392 (CERN-60-35) NOTES ON THE ELECTROSTATIC INSTABILITY OF NEUTRALIZED ELECTRON BEAMS. Tihiro Ohkawa. European Organization for Nuclear Research, Geneva. Sept. 1, 1960. 33p.

An intense beam of electrons, neutralized by ions, which has been proposed for use in accelerators and thermonuclear devices, suffers from the two-stream instability. Three possible ways for obtaining a stable beam are by building up the beam while it is at very high energy, by using initially high-temperature plasma, or by applying a very strong electric field. The stability criteria for these three cases were obtained by using the theoretical method. (W.L.H.)

3393 (COO-272) A METHOD OF DETERMINING TOTAL U-235 IN FLAT CONFIGURATIONS. Fred K. White and Ronald B. Perry. Chicago Operations Office, AEC and Argonne National Lab., Ill. Nov. 1960. 26p. OTS.

A method for determining U^{235}, utilizing the 184-kev γ from the decay of U^{235}, is described. There are no interfering γ's in this energy range from the decay of the other uranium isotopes. The method is applicable to all flat configurations providing the self-absorption does not exceed 40 to 50%. A $2.5 \times 2.5 \times 0.001$ in. foil of highly enriched uranium of known weight and isotopic content is used as a standard. Four series of counts are taken with a single-channel scintillation spectrometer with the window on the 184-kev peak and a window width of 4%. (W.D.M.)

3394 (KAPL-2000-11(p.III,30-III,40)) DETERMINATION OF THERMAL CROSS SECTIONS AND RESONANCE INTEGRALS OF SOME FISSION PRODUCTS. H. M. Eiland, E. B. Fehr, E. C. Hansen, and J. L. Mewherter. Knolls Atomic Power Lab., Schenectady, N. Y.

In connection with an extensive experimental program for the determination of effective (pile neutron) fission-product cross sections, the thermal cross section and resonance integrals (RI) of Cs^{133}, Pr^{141}, and Sm^{152}, and the resonance integral of U^{236} were determined by a series of bare and cadmium-covered activations in the Thermal Test Reactor (TTR). The main purpose of these measurements was to check experimental and analytical methods by comparing the results with published data. (auth)

3395 (NDA-2131-27) NEUTRON CROSS SECTIONS FOR DEUTERIUM. Herbert Goldstein. Nuclear Development Corp. of America, White Plains, N. Y. Oct. 10, 1960. 9p. Contract AT(30-1)2303(IX). OTS.

Tables are presented for fast-neutron cross sections for deuterium at 18.02 Mev and 099.4 kev and for the coefficient $f_l(E)$ for l = 1 at 12.2 kev to 89.9 Mev. (C.J.G.)

3396 (NP-9269) ANGULAR DISTRIBUTION OF THE REACTION $^9Be(^6Li, ^7Li)^8Be$. L. Marquez and C. Redon. Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas. 1960. 9p. (Notas de Física Vol. VI, No. 4).

The reaction $Be^9(Li^6, Li^7)Be^8$ was studied with 2.0-Mev Li^6. The angular distribution in the center-of-mass system exhibited a forward-backward asymmetry with a broad peak at 75°, indicating a direct-interaction mechanism. (C.J.G.)

3397 (NP-9279) SORPTION IN ALPHA-BRASS. M. L. Swanson and R. F. Mehl. Carnegie Inst. of Tech., Pittsburgh. Metals Research Lab. Sept. 1, 1960. 63p. Contract Nonr 760(08).

Experiments to examine aspects of bimetallic sorption were conducted. The rate of approach to equilibrium of the surface composition of α-brass solid-vapor couples was determined by an optical reflectivity method. Analysis of results showed that bulk diffusion is dominant in determining this rate; the results indicate a small ($\sim 10^{-3}$) value of the condensation coefficient for a clean, imperfect surface. (J.R.D.)

3398 (TID-6709) RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Progress Report. M. L. Wiedenbeck. Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts. Aug. 1960. 161p. Contract AT(11-1)-724. (UMRI-2863-2-P). OTS.

Nine papers are presented on nuclear spectroscopy work including a report on preliminary work concerning the unscrambling of γ spectra. Separate abstracts were prepared for the nine papers. (W.D.M.)

3399 (TID-6709(Sect.I)) NEUTRON-CAPTURE GAMMA RAYS OF IRIDIUM. P. A. Treado and P. R. Chagnon. Sect. I of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts. 10p.

A sample of natural iridium metal, which contains both Ir^{191} and Ir^{193}, was placed in a pile neutron beam, and the emitted capture γ rays were studied by means of a three-crystal scintillation spectrometer. Previously unreported γ rays of 1.95, 2.48, 2.82, 3.97, 4.19, and 4.32 Mev were found. The present measurements of the ground-state γ rays are in agreement with mass-spectrometer values of R. A. Demirkhanov et al. (auth)

3400 (TID-6709(Sect.II)) NEUTRON-CAPTURE GAMMA RAYS OF NICKEL. P. A. Treado and P. R. Chagnon. Sect. II of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts. 20p.

A sample of nickel oxide powder and three metallic samples isotopically enriched in Ni^{58}, Ni^{60}, and Ni^{62}, respectively, were placed in a reactor neutron beam and the emitted capture γ rays were studied by means of a single scintillation crystal and a three-crystal scintillation spectrometer. Most of the natural-nickel γ rays were assigned to at least one of the three isotopes studied. The high-energy γ rays of Ni^{59} and Ni^{61} agree, within experimental errors, with proton-group energies previously measured in $Ni^{58}(d,p)Ni^{59}$ and $Ni^{60}(d,p)Ni^{61}$ experiments. The neutron-binding energies were found to be 8.99, 7.81, and 6.80 Mev for Ni^{59}, Ni^{61}, and Ni^{63}, respectively. (auth)

3401 (TID-6709(Sect.VIII)) EXCITED STATES OF Xe^{128}. R. G. Arns, R. E. Sund, L. I. Yin, and M. L. Wiedenbeck. Sect. VIII of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Harrison M. Randall Lab. of Physics. 4p.

Gamma transitions in Xe^{128} following decay of the 25-min I^{128} were studied using coincidence and directional-correlation techniques. Conversion electrons corresponding to these γ transitions were observed in a magnetic spectrometer. The measurements confirmed the existence of excited states at 441 kev (2+) and 1008 kev (2+). Tentative evidence was found for a 0+ excited state at 1019 kev which is de-excited by a γ transition to the first-excited state and by an internally converted crossover to the ground state. (auth)

3402 (TID-6709(Sect.IX)) ENERGY LEVELS OF Re^{187}. R. G. Arns and M. L. Wiedenbeck. Sect. IX of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Harrison M. Randall Lab., of Physics. 29p.

The γ rays of Re^{187} following β decay of the 24-hr W^{187} were studied using prompt and delayed coincidence techniques. A total of 25 γ rays were found. Relative intensities are given for the γ transitions. The directional correlation of the 552- 134-kev cascade was measured. A decay scheme is proposed on the basis of the coincidence measurements. Spins and parities of the principle levels are discussed. (auth)

3403 (TID-6709(Sect.X)) ANALYSIS OF GAMMA-GAMMA POLARIZATION-DIRECTIONAL CORRELATIONS INVOLVING MULTIPOLE MIXTURES. M. B. Martin, R. G. Arns, and M. L. Wiedenbeck. Sect. X of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Harrison M. Randall Lab. of Physics. 9p.

A method is described for the graphical analysis of the γ-γ polarization-directional correlation when one or both γ rays involve a mixture of dipole and quadrupole radiation. The case in which the polarization of the mixed γ ray is observed is treated in detail. (auth)

3404 (TID-6709(Sect.XI)) THE LEVEL STRUCTURE OF Eu^{153}. R. E. Sund and M. L. Wiedenbeck. Sect. XI of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. Harrison M. Randall Lab. of Physics. 34p.

Gamma rays in Eu^{153} following the decay of Sm^{153} and Gd^{153} were studied using coincidence and angular-correlation methods. Results for the strong transitions are in agreement with the decay scheme given by McCutchen. Measurements were made of spectra of γ rays in coincidence with the x-ray, 70-, 97-, and 103-kev transitions in the decay of Gd^{153}, and with eight energy regions in the decay of Sm^{153}. A number of new, weak transitions were observed in the decay of Sm^{153}, and a consistent decay scheme is proposed. Directional corre-

lation measurements were made on the 70–103-kev cascade from the decay of Sm^{153} and from the decay of Gd^{153}. Possible spin assignments are discussed. (auth)

3405 (TID-6709(Sect.XIII)) THE EXPERIMENTAL MEASUREMENT OF THE DEGRADED GAMMA RAY ENERGY SPECTRUM. Preliminary Report. J. I. Trombka and M. L. Wiedenbeck. Sect. XIII of RESEARCH IN THE FIELD OF NUCLEAR SPECTROSCOPY. Michigan. Univ., Ann Arbor. 24p.

A method for determining the true γ-ray energy spectrum from the pulse-height spectrum measured using an NaI(Tl) scintillation detector is developed. The polyenergetic γ pulse-height spectrum is synthesized by using a series of normalized pulse-height distributions characteristic of the various monoenergetic components in the beam. The contribution of each of the monoenergetic components to the pulse-height spectrum is determined using least-mean-square fitting techniques. From a knowledge of the contribution of each monoenergetic component and crystal efficiency for each given energy, the true energy spectrum incident upon the crystal can be determined. Experimental results are presented. Methods for extending this technique to the analysis of continuous γ-ray energy spectra are also discussed. The shape of the pulse-height spectra and also the crystal efficiencies are dependent upon source-detector geometry for cylindrical NaI(Tl) crystals. Experimental and theoretical results indicate that this geometric dependence can be eliminated if spherical crystals are used. Thus in those cases where source-detector geometry cannot be specified, γ-energy spectra can still be determined from the measurement of pulse-height spectra. (auth)

3406 (TID-6842) THE POLARIZATION OF NEUTRONS FROM THE $Li^7(p,n)Be^7$ REACTION. [PART] II. S. M. Austin, S. E. Darden, A. Okazaki, and Z. Wilhelmi. Wisconsin. Univ., Madison. [1960]. 37p. OTS.

The polarization of neutrons from the $Li^7(p,n)Be^7$ was studied by measurements of the left-right asymmetry in the scattering of neutrons from a liquid-oxygen analyzer. Angular distributions of the polarization were measured at 2.2, 2.6, and 3.0 Mev and angles (lab. system) of 30 to 70°, 30 to 115°, and 30 to 70°, respectively. Measurements for neutrons emitted at 50° were made at proton energies of 2.1 to 3.1 Mev. (C.J.G.)

3407 (UCRL-2248) ON NEUTRON EVAPORATION FROM EXCITED NUCLEI. Frank L. Adelman. California. Univ., Berkeley. Radiation Lab. June 18, 1953. 2p. OTS.

Two experiments concerning neutron evaporation from excited nuclei are briefly discussed: a measurement of the number and energy spectrum of the protons and α-particles emitted in the high-energy bombardment of uranium with p, d, and α; and fission-neutron emission in reactions of low-energy protons with thorium. (W.D.M.)

3408 (UCRL-9325) PERTURBATION OF ALPHA-GAMMA ANGULAR CORRELATIONS IN TRANSURANIUM ISOTOPES (thesis). Eileen Flamm. California. Univ., Berkeley. Lawrence Radiation Lab. Aug. 1960. 58p. Contract W-7405-eng-48. OTS.

The perturbation of α-γ angular correlations was studied in Am^{241}, Am^{243}, and Cm^{243} by observing α particles in coincidence with γ rays from daughter nuclei recoiling into vacuum, air, aluminum, silver, iron, Mylar, water, and benzene. Attenuation coefficients below the hard core value for a static interaction were obtained in vacuum, indicating that fluctuating magnetic fields or electric field gradients are present at the daughter nuclei during the recoil motion. Significantly larger anisotropies were obtained in nonmagnetic metals than in iron or in insulators. The magnetic and electric moments of the intermediate nuclear states in the α-γ cascades are estimated, and the configuration of the electron shell following α decay is considered. Extra-atomic electric fields at the daughter nuclei during and after the recoil motion are discussed with reference to current theories of radiation damage and the chemical behavior of the actinides. The results and interpretations of previous α-γ angular correlations are reviewed. From the observed correlations in Cm^{243}, a lower limit can be set for the E2/M1 mixing ratio δ^2 of the 278 kilovolt γ ray in Pu^{239} and the sign of δ is determined. (auth)

3409 (UCRL-9385) SEARCH FOR A 0^+, 2^+, 4^+ TRIPLET IN THE VICINITY OF 1.140 Mev IN Pd^{106}. Horacio E. Bosch and Daniel J. Horen. California. Univ., Berkeley. Lawrence Radiation Lab. Sept. 1960. 16p. Contract W-7405-eng-48. OTS.

The β and γ radiation from the disintegration of Rh^{106} was analyzed by means of single and coincidence measurements with scintillation counters for a 0^+, 2^+, 4^+ triplet of 1.140 Mev in Pd^{106}. A double level at an energy of 1.140 Mev in Pd^{106} was found. A disintegration scheme is proposed for the excited levels of Pd^{106} populated from Rh^{106}. (auth)

3410 (CEA-tr-R-989) DÉSINTÉGRATION DE L'ISOMÈRE DU ^{210}Bi. (Decay of the Isomer of Bi^{210}). S. V. Golenetskiĭ (Goblennetski), L. I. Rusinov, and Yu. (Y.) I. Filimonov. Translated into French by M. Kefeli from Zhur. Eksptl'. i Teoret. Fiz. 35, 1313-15(1958). 5p.

A study was made of the decay of the 2.6×10^6-year isomer of Bi^{210} which emits α particles at 4935 ± 20 kev. An α spectrum and decay scheme are offered. New α particles of 4900 ± 10 kev and 4640 ± 30 kev were established. The relative intensities of the 3-α transitions are 60, 30, and 10%. About 10% of the decays are accomplished by γ rays of 260 ± 10 kev and 300 ± 10 kev with relative intensities of 1 and 0.4. (T.R.H.)

3411 THE STATISTICAL MODEL AND NUCLEAR LEVEL DENSITIES. Torleif Ericson (Massachusetts Inst. of Tech., Cambridge). Advances in Phys. 9, 425-511(1960) Oct.

A treatment from a theoretical point of view is given for the different aspects of the statistical model and nuclear level densities. General features of nuclear level densities, including angular momentum and parity distributions, are discussed. Several models for their description are given including the equidistant spacing model, the free gas model, the Newton-Cameron model, the Rosenzweig effect, the Newson model, the pairing model, and the nuclear phase transition. The shell model without pairing interactions seemed to provide an adequate description of the neutron binding energy with empirical values of the single-particle spacing. Qualitative considerations, formal solution of classical approximation, and special limits of the statistical model and angular momentum conservation are discussed. The evaporation approximation, inverse cross sections, multiple emission of particles, emission of complex particles, statistical fission, lifetime of the compound state, and fluctuation of cross sections and angular distributions are also discussed. (M.C.G.)

3412 POINT OF VIEW FOR THE INTERPRETATION OF GAS-COOLED SHIP REACTORS. D. Smidt (Deutsche Babcock & Wilcox-Dampfkesselwerke A. G., Oberhausen, Ger.). Atomkernenergie 5, 361-6(1960) Oct. (In German)

The design philosophy of gas-cooled ship reactors is described. The special techniques of heat transfer, neutron

physics, and materials are explained. Reasons are given for some of the advantages of gas cooling, namely low weight of shielding, simple construction, a cheap conventional secondary circuit, and high safety under normal and abnormal conditions. As a conclusion some details are given of a design study already done. (auth)

3413 DESIGN FOR SATURATED STEAM CYCLE WITH AN ORGANIC MODERATED AND COOLED SHIP REACTOR. H. Daldrup (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt, Hamburg). Atomkernenergie 5, 366-71(1960) Oct. (In German)

A method of designing saturated steam cycles with nuclear reactors is discussed. For several parameters the over-all thermal efficiencies are plotted in diagrams. For a 10,000-shp-tanker with an organic-moderated and -cooled reactor (OMR) the optimal pressure of the secondary loop is fixed corresponding to the demands of good over-all thermal efficiency and reasonable dimensions of the heat exchangers. (auth)

3414 MECHANISM AND DIFFERENTIAL CROSS-SECTIONS AS FUNCTIONS OF ENERGY FOR (d,p) REACTIONS. V. B. Belyaev, B. N. Zakhar'ev, and V. G. Neudachin. Atomnaya Energ. 9, 298-300(1960) Oct. (In Russian)

The Born approximation for stripping is used in an analysis of the cross sections of (d,p) reactions as a function of energy. The magnitude γ^2, participating in the formula as a multiplier, is also studied as a function of energy. High energy deuterons ($E_d > 4$ Mev) were used to avoid corrections in the Butler formula for determining γ^2 as a function of E_d. The results of experiments with $C^{12}(d,p)C^{13}$, $Be^9(d,p)Be^{10}$, $O^{16}(d,p)O^{17}$, and $N^{14}(d,p)N^{15}$ are tabulated. The relative and absolute magnitudes of the γ^2 widths vary with the increase of E_d. It is shown that for quantitative spectroscopic analysis the Butler γ^2 widths are not reliable and that further studies are necessary to determine the absolute differential cross sections as functions of energy. Improved experimental data should produce the necessary information on the mechanism of (d,p) reactions for supplementing the information on forbidden and heavy particle stripping. (R.V.J.)

3415 γ SPECTRA OF Tm^{165} AND Tm^{167}. S. Chojnacki, A. Jasiński, W. Kusch, J. Kownacki, H. Lancman, and J. A. Yutlandov (Inst. for Nuclear Research, Polish Academy of Sciences and Joint Inst. for Nuclear Research, Dubna, USSR). Bull. acad. polon. sci., Sér. sci., math., astron. et phys. 8, 407-11(1960). (In English)

The γ spectra of the neutron-deficient isotopes Tm^{165} and Tm^{167} were investigated. The measurements were made with a scintillation spectrometer, a 100-channel pulse analyzer, and an amplifier with pulse formed by shortened delay line. In the measurements on Tm^{165} the following γ transitions were observed: 243, 292, 354, 810, 1172 ± 12, 1398 ± 12, and 2007 ± 25 kev. The existence of the 2007-kev transition was confirmed by additional measurements. The purpose in the study of the Tm^{167} γ spectrum was to eliminate the uncertainty as to the existence of the 515- and 720-kev transitions and to search for γ transitions observed in the decay of Ho^{167}. Transitions at 208 and 527 kev were observed, and their relative intensities were measured. The results obtained are in agreement with spin 5/2 and odd parity of the 735-kev level in Er^{167}. (J.S.R.)

3416 NUCLEAR STRUCTURE OF $_{10}Ne$ AND $_{12}Mg$. C. G. Bedreag (Academia R. P. R., Iaşi). Bul. inst. politeh. Iaşi (N.S.) 5(IX), 143-50(1959). (In French)

An examination is made of the nuclear structure of three isotopes, Ne^{21}, Ne^{20}, and Mg^{24}, which belong to three different nuclear models. The nuclear spectrum of Ne^{21} shows harmonics up to the 7th excitation degree and also a fusion of the four nuclear models. The ellipsoid form of Ne^{20} lends itself to rotation movements, and three different excitation degrees and moments of inertia are ascertained. The supplementary moment is zero. The rotational-vibrational fusion of the Mg^{24} spectrum is illustrated in tabular form. Calculation of the moments of inertia indicates deformation of the excited state. (J.S.R.)

3417 SOME EXPERIMENTS ON THE FORM OF RESONANCE LINES IN A RIGID LATTICE. Anatole Abragam and Jacques-Michel Winter. Compt. rend. 249, 1633-4(1959) Oct. 28. (In French) (CEA-1371)

The nuclear resonance signals of K^{39} and Ag^{109} nuclei in KF and AgF crystals were observed. The lines are much narrower than would be expected from the calculation of the second moment. This attenuation is due to the frequent reversals of the fluorine nuclei, which have a moment 20 times greater than those of the potassium and silver nuclei. (auth)

3418 THE SPECTRUM OF BERYLLIUM-8 PRODUCED DURING THE β DECAY OF LITHIUM-8. Roland Bilwes, Raymond Seltz, Claude Gérardin, and Denise Magnac-Valette. Compt. rend. 251, 1771-3(1960) Oct. 24. (In French)

The decomposition of Be^8 produced by the β decay of Li^8 was studied with the aid of two different spectrometric methods. The results are comparable. Only the 2.9-Mev level appears in the energy spectrum of the α particles analyzed. (tr-auth)

3419 LINEARITY ANOMALY IN FERMI DIAGRAM OF P^{32}. V. Brabec and M. Vinduška (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Prague). Czechoslov J. Phys. 10, 614-15(1960). (In German)

A discrepancy is reported in the measured β spectrum of P^{32} and the Fermi diagram. (T.R.H.)

3420 MEAN NUMBER OF PROMPT NEUTRONS EMITTED IN THE FISSION OF U^{233}, Pu^{239}, AND Th^{232}. J. Leroy (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 617-28(1960) Aug.-Sept. (In French)

This report summarizes a set of measurements carried out at Saclay on the mean numbers of prompt neutrons emitted in the fission of several nuclei. These quantities were measured for U^{233}, Pu^{239}, and Th^{232} fissions induced by 14.2-Mev neutrons, relative to the U^{235} thermal fission $\bar{\nu}$ value: $^{235}_{92}\bar{\nu}$ (0.025 ev) = 2.47 ± 0.03. The following values were obtained: $^{239}_{94}\bar{\nu}$ (14.2 Mev) = 4.55 ± 0.15, $^{241}_{94}\bar{\nu}$ (14.2 Mev) = 4.75 ± 0.4, and $^{233}_{90}\bar{\nu}$ (14.2 Mev) = 4.64 ± 0.2. Another group of measurements gave the average number of prompt neutrons $^{233}_{92}\bar{\nu}(E)$ emitted per U^{233} fission induced by a fission neutron spectrum, and $^{238}_{92}\bar{\nu}$ (spontaneous) emitted per U^{238} spontaneous fission: $^{233}_{92}\bar{\nu}(E)$ = 2.89 ± 0.07, (E = 3.1 Mev) and $^{238}_{92}\bar{\nu}$ (spontaneous) = 2.10 ± 0.08. (auth)

3421 NUCLEAR REACTIONS PROVOKED BY "HEAVY" IONS. INTEREST AND VARIOUS APPLICATIONS. M. Lefort (Faculté des Sciences, Paris). J. phys. radium 21, 665-73(1960) Aug.-Sept. (In French)

A survey is given of nuclear phenomena induced by multicharged heavy ions. Several features are discussed which include reactions involving a fusion nucleus, "buckshot" reactions in which heavy ions are broken into several fragments in the vicinity of target nuclides, disintegration stars, and transfer reactions. The usefulness of heavy ion

reactions for measuring fission width and Γ_n/Γ_f ratios, is emphasized. Also the production of neutron deficient nuclides and of transuranium elements is discussed. 46 references. (auth)

3422 RELATIVE NUCLIDIC MASSES. F. Everling, (Max-Planck-Institut für Chemie(Otto-Hahn-Institut), Mainz), L. A. König, J. H. E. Mattauch, and A. H. Wapstra. Nuclear Phys. 18, 52-69(1960) Sept. (2). (In English)

An accompanying table gives a complete and consistent list of nuclidic masses, computed with least squares methods from all significant experimental data available, together with the binding energies and derived β^- decay energies. The mass excess is given for each nuclide in the scales in which the nuclidic mass of C^{12} is exactly 12 units and the mass of O^{16} is exactly 16 mass units. A tabulation is given for the arrangement of the periodic table in the ten ranges, and the number of masses and input data in each range. (B.O.G.)

3423 ELECTRODISINTEGRATION OF Ta AND Au NUCLEI. W. C. Barber and T. Wiedling (Stanford Univ., Calif.). Nuclear Phys. 18, 575-86(1960) Sept. (2). (In English)

Yield curves were measured for the production of 5.6-day Au^{198} and 30-sec Au^{195} from Au^{197}, and of 8.1-hr Ta^{180}, 2.1-hr Ta^{178}, and 9.3-min Ta^{178} from Ta^{181}, in foil stacks that were bombarded by electrons. The results were analyzed to compare the yields resulting from the direct effect of the electrons with those resulting from bremsstrahlung from the electrons. The comparison shows that the direct effect is relatively larger than is predicted by existing theories of electrodisintegration if the transitions being excited are entirely electric dipole. Agreement with the theory can be obtained if electric monopole and quadrupole transitions are assumed present. The theory makes use of approximations which are probably not valid for nuclei with high Z. If there is a monopole resonance in the region of 25 to 40 Mev excitation, its contribution to the 2n and 3n reactions is less than 30% of the contributions of higher multipoles to these reactions. (auth)

3424 ENERGIES OF ALPHA PARTICLES. Aaldert H. Wapstra (Instituut voor Kernphysisch Onderzoek, Amsterdam and Technische Hogeschool, Delft, Netherlands). Nuclear Phys. 18, 587-95(1960) Sept. (2). (In English)

Energies of α particles emitted in ground-state transitions between nuclei with mass < 200 were computed from experimental data obtained with magnetic spectrometers using the newest calibration results. (auth)

3425 INTRINSIC QUADRUPOLE MOMENTS OF DEFORMED NUCLEI AND SUPERFLUIDITY IN NUCLEI. Norman K. Glendenning and Jerzy Sawicki (Univ. of California, Berkeley). Nuclear Phys. 18, 596-614(1960) Sept. (2). (In English)

Intrinsic quadrupole moments of deformed nuclei are calculated on a completely particle picture as a function of the atomic number Z and the parameter of spheroidal distortion of the well in which the independent particles move. The effects of the pairing force responsible for the superfluid property of the existence of an energy gap are examined by using the Green's function method of Migdal. The deformation of the single-particle potential well is treated (a) as a perturbation and (b) exactly, by using the Nilsson and Mottelson-Nilsson energy spectra and wave functions. It is necessary to include the configuration mixing with the major harmonic-oscillator shells $N' = N \pm 2$ caused by the deformation. In order to account for the observed quadrupole moments, slightly smaller values of the Nilsson deformation parameter are required than those following from the uniform-charge model. The effect of the energy gap is to smear out the shell-closure effects. As a result, the dependence of quadrupole moments on Z is similar to that predicted by the uniform-charge model. (auth)

3426 INTEGRATED CROSS SECTIONS FOR THE REACTIONS $A^{40}(\gamma,p)$ AND $A^{40}(\gamma,np)$. H. G. Dosch and K. H. Lindenberger (Universität, Heidelberg, Ger.). Nuclear Phys. 18, 615-23(1960) Sept. (2). (In English)

The (γ,p) and (γ,np) reactions in Ar^{40} were re-examined with 34-Mev bremsstrahlung by measuring the product chlorine radioactivities. Details of the sample preparation are given. Yields relative to $C^{12}(\gamma,n)$ and $Cu^{63}(\gamma,n)$ were determined by β counting. From additional measurements with a lead absorber in the beam, the following cross sections integrated to 33 Mev were deduced: (100 ± 15) Mev·mb for (γ,p) and (25 ± 10) Mev·mb for (γ,np). This excludes definitely the anomalously high cross section values previously reported. An approximate yield for the $(\gamma,2p)$ process is given. (auth)

3427 A NEW ISOTOPE: CADMIUM-103. Ivor L. Preiss, Peder J. Estrup, and Richard Wolfgang (Yale Univ., New Haven). Nuclear Phys. 18, 624-7(1960) Sept. (2). (In English)

A new activity, produced by 160-Mev O^{16} bombardments of thick molybdenum oxide targets, is assigned to Cd^{103} on the basis of chemistry and its decay to Ag^{103}. The isotope Cd^{103} has a half life of 10 ± 1.5 min and decays by positron emission accompanied by 0.22, 0.62, and 0.85 Mev γ rays. (auth)

3428 ABSOLUTE CROSS-SECTIONS OF $C^{12}(p,pn)C^{11}$ FROM 288 TO 383 Mev. Vastupal Parikh (Nuclear Physics Research Lab., Liverpool). Nuclear Phys. 18, 628-37(1960) Sept. (2). (In English)

The excitation function for the reaction $C^{12}(p,pn)C^{11}$ is measured in the external proton beam of a 396-cm synchrocyclotron. The C^{11} activity is measured by a calibrated γ-ray G-M counter. The results are compared with those reported from other laboratories. (auth)

3429 CROSS-SECTIONS FOR $Al^{27}(p,3pn)Na^{24}$, $Al^{27}(p,5p5n)F^{18}$ AND $C^{12}(p,3p3n)Be^{7}$ RELATIVE TO $C^{12}(p,pn)C^{11}$ Vastupal Parikh (Nuclear Physics Research Lab., Liverpool). Nuclear Phys. 18, 638-45(1960) Sept. (2). (In English)

The excitation functions for the reactions $Al^{27}(p,3n3p)Na^{24}$, $Al^{27}(p,5n5p)F^{18}$, and $C^{12}(p,3n3p)Be^{7}$ are measured relative to $C^{12}(p,np)C^{11}$ employing internal proton beam of a 396-cm synchrocyclotron. The results are compared with those reported from other laboratories. (auth)

3430 THE ACTIVITIES INDUCED IN BERYLLIUM, OXYGEN AND FLUORINE BY PROTONS OF 220 Mev TO 362 Mev. Vastupal Parikh (Nuclear Physics Research Lab., Liverpool). Nuclear Phys. 18, 646-53(1960) Sept. (2). (In English)

The beryllium, oxygen, and fluorine targets are bombarded in the internal proton beam of a 396-cm synchrocyclotron. The reaction cross sections for various spallation products are measured at different energies. The behavior of high-energy proton induced reactions in some light elements is discussed. (auth)

3431 HOLE-HOLE INTERACTIONS AND THE PROPERTIES OF NUCLEAR MATTER. S. A. Moszkowski (Univ. of California, Los Angeles) and A. M. Sessler (Ohio State

Univ., Columbus). Nuclear Phys. 18, 669-71(1960) Sept. (2). (In English)

The contribution of hole-hole interaction to the ground-state energy of nuclear matter is estimated for a mutual interaction containing a repulsive core and an exponential well outside, and is found to be only about ½ Mev per particle. (auth)

3432 REDUCED WIDTHS IN O^{16} AND GAMMA TRANSITION PROBABILITIES IN F^{19}. B. Roth and K. Wildermuth (Florida State Univ., Tallahassee). Nuclear Phys. 20, 10-14(1960) Oct. (2). (In English)

Reduced widths in O^{16} and γ transition probabilities in F^{19}, qualitatively predicted by the cluster model, are compared with experimental data. (auth)

3433 NUCLEAR RESONANCE ABSORPTION IN Dy^{161} SITUATED IN Dy_2O_3 AND DYSPROSIUM IRON GARNET. S. Ofer, P. Avivi, R. Bauminger, A. Marinov, and S. G. Cohen (Hebrew Univ., Jerusalem). Phys. Rev. 120, 406-8 (1960) Oct. 15.

The recoil-free resonant absorption of the 26-kev γ ray ($T_{\frac{1}{2}} \sim 3 \times 10^{-9}$ sec) emitted in the decay of Tb^{161} by absorbers containing Dy^{161} was investigated. High Mössbauer efficiencies at room temperatures were observed for sources and absorbers in the form of oxide and rare-earth iron garnet. The line shapes obtained were very broad, of the order of 100 times the natural widths, and showed no resolved lines. The broad lines are interpreted as due to a wide complicated hyperfine spectrum whose details were smoothed out by transitions between magnetic sublevels induced by paramagnetic relaxation. In the rare-earth iron garnet, the exchange field acting on the rare-earth ion should decouple the nuclear and electron spins. The effective magnetic field at the nucleus in the rare-earth garnet is about 2×10^6 oersted. (auth)

3434 HYPERFINE STRUCTURE OF THE METASTABLE $^3P_2$ STATE OF Cd^{111} AND Cd^{113}. W. Faust, M. McDermott, and W. Lichten (Columbia Univ., New York). Phys. Rev. 120, 469(1960) Oct. 15.

The hyperfine intervals of Cd^{111} and Cd^{113} (5s, 5p, $^3P_2$) are $\Delta\nu^{111}(F = 5/2, F = 3/2) = (8232.341 \pm 0.002)$ Mc/sec; $\Delta\nu^{113}(F = 5/2, F = 3/2) = (8611.586 \pm 0.004)$ Mc/sec. The measured hyperfine anomaly is $(0.0016 \pm 0.0003)\%$. (auth)

3435 EXPERIMENTAL STUDY OF THE MECHANISM OF (p,t) REACTIONS AT 22 MEV. J. B. Ball and C. D. Goodman (Oak Ridge National Lab., Tenn.). Phys. Rev. 120, 488-91(1960) Oct. 15.

Energy distributions of tritons from various elements throughout the periodic table show prominent peaks which can be identified with states in the residual nucleus which result from the removal of two neutrons from single-particle states in the target. This is indicative of a double pickup mechanism for the (p,t) reactions at this energy. The use of this reaction in identifying the position and character of single-particle levels is illustrated. The reaction is used to determine the mass of Ru^{101}. (auth)

3436 $Be^9(\alpha,n)C^{12}$ REACTION AND THE PARAMETERS OF THE 7.66-MEV STATE OF C^{12}. F. Ajzenberg-Selove (Haverford Coll., Penna.) and P. H. Stelson. Phys. Rev. 120, 500-4(1960) Oct. 15.

The $Be^9(\alpha,n)C^{12}$ reaction was studied at $\bar{E}_\alpha$ = 5.6 and 5.78 Mev. Neutron groups were observed at the first three states of C^{12}. The ratio of the population of the 4.43- and 7.66-Mev states was determined to be 8.1 ± 1 at $\bar{E}_\alpha$ = 5.6 Mev. This value, together with information from a number of other sources, demonstrates that the 7.66-Mev state has $J^\pi = 0^+$, that its width for α emission is approximately the Wigner limit ($\Gamma \sim 8$ ev), and that in $\sim 10^{-3}\%$ of the cases the state decays to the ground state of C^{12} by pair emission. It is estimated that the 7.66-Mev state can decay by γ emission via the 2^+, 4.43-Mev state with a probability of 1/5000. This information reinforces the proposal that the 7.66-Mev state has the necessary properties to participate in the buildup of the elements in red giant stars. (auth)

3437 SHELL MODEL AND Pb^{208}. J. C. Carter, William T. Pinkston, and William W. True (Princeton Univ., N. J.). Phys. Rev. 120, 504-12(1960) Oct. 15. (PUC-1960-10)

The lowest odd-parity excited energy levels of Pb^{208} were calculated by a shell-model approach, considering a single proton or a single neutron to be excited out of the Pb^{208} core. Both a singlet-even plus triplet-even force and a Rosenfeld force were used as the two-particle interaction. A zero-range force was considered. There were no other arbitrary parameters. The results with the various forces indicate that it is impossible to get a 3− state low enough to be interpretated as the observed 2.615-Mev 3− level. The results support the conclusion that the 3− level at 2.615 Mev in Pb^{208} is primarily the result of a collective octupole oscillation. (auth)

3438 TIME DEPENDENCE OF RESONANTLY FILTERED GAMMA RAYS FROM Fe^{57}. F. J. Lynch, R. E. Holland, and M. Hammermesh (Argonne National Lab., Ill.). Phys. Rev. 120, 513-20(1960) Oct. 15.

The time dependence of γ rays emitted by the 14.4-kev state of Fe^{57} was studied by delayed-coincidence measurements between a 123-kev γ ray preceding formation of the state and the 14.4-kev γ ray from the state. When no filter was used, the number of γ rays decreased exponentially with the known half life of 0.1 μsec. When a foil of Fe^{57} (which was resonant to 14.4-kev radiation) was used as a filter, the number of γ rays observed through the filter did not decrease exponentially. Instead, the filter absorbed almost none of the γ rays first emitted by the 14.4-kev state; at later times the absorption increased. Data were taken with three different thicknesses of absorber and with emission and absorption peaks separated by 0 to 11 times the width of the resonance. The energy separation resulted from the Doppler shift associated with a constant velocity between source and absorber. These data were, for the most part, in good accord with the prediction of a theory based on a classical model for absorber and source. In particular, the results verified the theoretical prediction that at certain times the intensity of radiation observed would be greater with the filter than without it. (auth)

3439 NEUTRON TOTAL CROSS SECTIONS IN THE 17- TO 29-MEV REGION. J. M. Peterson, A. Bratenahl, and J. P. Stoering (Univ. of California, Livermore). Phys. Rev. 120, 521-6(1960) Oct. 15. (UCRL-5717)

The neutron total cross sections of 42 elements and isotopes were measured at several energies between 17 and 29 Mev using monoenergetic neutrons produced by the Livermore variable-energy cyclotron through the $T(d,n)He^4$ reaction. Beam contaminations by γ rays and low-energy "breakup" neutrons were measured by time-of-flight techniques, and their effects were kept small by suitably high bias on the plastic scintillator detector. The accuracy in cross section is typically ±1 to 2%. The data in this energy region have been sparse heretofore. Where comparisons with previous data were possible, there is substantial agreement. When plotted as a function of energy and mass number, the data form a smooth cross-section surface

which joins on smoothly to the data at lower energies. The data seem in good agreement with the predictions of the optical model of Bjorklund and Fernbach. (auth)

3440 $Ti^{46,48}(d,p)Ti^{47,49}$ REACTIONS AND THE $1f^{n}_{7/2}$ AND $1f^{n-1}_{7/2}2p$ CONFIGURATIONS. L. H. Th. Rietjens (Univ. of Michigan, Ann Arbor), O. M. Bilaniuk, and M. H. Macfarlane. Phys. Rev. 120, 527-35(1960) Oct. 15.

The nuclide Ti^{47} was investigated via a high-resolution spectroscopic study of the reaction $Ti^{46}(d,p)Ti^{47}$. The observed levels, the measured orbital angular momenta of the captured neutrons, and the tentative total angular momenta assigned on the basis of relative intensities were as follows: ground state, 0.16 Mev, $l_n = 3$, $J^\pi = 7/2^-$; (0.55 Mev, $J^\pi = 3/2^-$); 1.56 Mev, $l_n = 1$, ($J^\pi = 3/2^-$); 1.80 Mev, $l_n = 1$, ($J^\pi = 3/2^-$); 2.58 Mev, $l_n = 1$; 2.83 Mev, $l_n = 1$; 3.31 Mev, $l_n = 1$, ($J^\pi = 1/2^-$ or $3/2^-$); 3.60 Mev, ($l_n = 1$, $J^\pi = 1/2^-$); 3.71 Mev, ($l_n = 1$, $J^\pi = 1/2^-$); and 3.95 Mev, ($l_n = 1$, $J^\pi = 1/2^-$). Similarly for Ti^{49}: ground state, $l_n = 3$, $J^\pi = 7/2^-$; 1.38 Mev, $l_n = 1$, $J^\pi = 3/2^-$; 1.72 Mev, $l_n = 1$, ($J = 3/2^-$); 2.44 Mev; 2.49 Mev; 3.17 Mev, ($l_n = 1$, $J^\pi = 1/2^-$); and 3.26 Mev, $l_n = 1$, ($J^\pi = 1/2^-$). It is shown that the ground state of Ti^{49} and the ground-state triplet of Ti^{47} can be accounted for by pure $f^{n}_{7/2}$ configurations, and that most of the observed levels can be associated with $1f^{n-1}_{7/2}2p_{3/2}$ and $1f^{n-1}_{7/2}2p_{1/2}$ configurations. (auth)

3441 K-ELECTRON EXCITATION ACCOMPANYING K CAPTURE IN Cs^{131}. N. L. Lark and M. L. Perlman (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 536-42(1960) Oct. 15. (BNL-4810)

The probability of production of an atom with a completely vacant K shell by excitation of the second K electron during the K-electron capture process was determined to be $(2.5 \pm 0.2) \times 10^{-5}$ per K-capture event in Cs^{131}. A scintillation-coincidence spectrometer with a coincidence resolution time of 10 millimicroseconds for 30-kev x rays was used for the measurement. The half life of Cs^{131} was redetermined to be 9.69 ± 0.05 days. Previous measurements of electron-excitation phenomena accompanying K capture are summarized and the results are compared with the theory of Primakoff and Porter. (auth)

3442 FISSION OF RADIUM BY 11- TO 22-MEV PROTONS. Robert L. Wolke (Univ. of Florida, Gainesville). Phys. Rev. 120, 543-8(1960) Oct. 15.

The ranges and relative yields of Sr^{91} and Pd^{112} fragments from the fission of Ra^{226} by 11- to 22-Mev protons were determined by a radiochemical recoil-catching technique. The relative yield data indicate that above 11 Mev the three-humped mass-yield curve becomes predominantly "symmetric" and perhaps somewhat narrower. An apparent fission threshold of ~10.4 Mev was observed. The curve of total fission yield as a function of energy has the same slope between 13 and 22 Mev as was reported for the fast-neutron-induced fission of radium. The ranges in mg Au/cm^2 at 11 and 20 Mev, respectively, are, Sr^{91}: 11.2 ± 0.9 and 10.8 ± 0.2; Pd^{112}: 9.1 ± 1.0 and 9.2 ± 0.3, corresponding to an average total kinetic energy of 162 ± 10 Mev. (auth)

3443 DOUBLE BETA DECAY. [PART] II. Lothar Meichsner (Otto-Hahn-Institut, Mainz). Phys. Rev. 120, 552-5(1960) Oct. 15.

General formulas are given for the differential probability of allowed double β decay of nonoriented nuclei holding for any initial angular momentum and all possible final angular momenta according to the theory of Feynman and Gell-Mann. Six different combinations of reduced matrix elements occur. The decay probability for transitions $0 \rightarrow 2$ is small of second order compared with that for transitions $0 \rightarrow 0$. A lower limit for the half life of the transition $0 \rightarrow 2$ of $_{20}Ca_{28}$ is calculated as a function of the intermediate nuclear energy using j-j shell-model configurations. A slight generalization of the coupling constants suitable for two-neutrino decay is considered. (auth)

3444 RADIATIVE CAPTURE CROSS SECTIONS FOR FAST NEUTRONS. B. C. Diven, J. Terrell, and A. Hemmendinger (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 120, 556-69(1960) Oct. 15.

Neutron-capture cross sections were measured for 28 elements at neutron energies of 175 to 1000 kev. The method used was detection of capture γ radiation in a 1-m-diameter liquid scintillator, the capture samples being placed at the center for irradiation by a pulsed neutron beam. Absolute cross sections were determined by comparison with the known capture-plus-fission cross section of U^{235}; both capture and fission events are detected with nearly 100% efficiency in this arrangement. Corrections were made for loss of capture-γ-ray energy, by means of pulse-height analyses and comparison between 1-m and 48-cm scintillator results; corrections were made for change in path length due to scattering. The results obtained appear to agree reasonably well with the predictions of resonance theory, with level densities given by the Fermi gas model together with the effective ground state of Hurwitz and Bethe. The low capture cross sections of magic-number target nuclides appear well correlated with the magic-number effects on the mass. (auth)

3445 MOMENTUM IMPARTED TO COMPLEX NUCLEI IN HIGH-ENERGY INTERACTIONS. Norbert T. Porile (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 572-81(1960) Oct. 15. (BNL-4785)

The momentum imparted to nuclei in the cascade process was calculated with the aid of the results of a recent Monte Carlo calculation. Results are presented for 0.46 to 1.84 bev protons incident on Ru^{100}, Bi^{209}, and U^{238}. The forward and transverse components of momentum of the residual nucleus exhibit a wide range of possible values and are, on the average, approximately equal. The average forward component of momentum increases linearly with the excitation energy of the residual nucleus. The relation between these two quantities leads to considerably lower values of the average excitation energy associated with experimentally determined values of the forward component of momentum than the relations used previously. The calculated momentum values are in most cases consistent with experimental results. (auth)

3446 TWO-NUCLEON L · S POTENTIAL IN PSEUDOSCALAR MESON THEORY. C. K. Iddings and P. M. Platzman (California Inst. of Tech., Pasadena). Phys. Rev. 120, 644-52(1960) Oct. 15.

Nonstatic corrections to the two-nucleon potential of Brueckner and Watson and of Gartenhaus are computed within the framework of the γ_5 theory. These terms appear as spin-orbit corrections of order μ/M to the static potentials. The S matrix is calculated in second and fourth order for a reduced form of the relativistic theory. The potential is chosen so as to duplicate this S matrix to the required order in the coupling constant and μ/M. To what extent the reduction of the γ_5 theory changes its character is considered. The resulting potentials are given in analytic form for no cutoff in momentum space and in numerical form for the Gaussian cutoff employed by Gartenhaus. Some additional static corrections are given to previous potentials. A qualitative comparison is made with the experimental

observations in nucleon-nucleon scattering, the fine structure in the splitting of the He^5 nucleus, and the contribution of the nonstatic potential to the magnetic moment of the deuteron. (auth)

3447 K-ELECTRON CAPTURE BRANCH OF Sr^{87m}. A. W. Sunyar and M. Goldhaber (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 871-3(1960) Nov. 1. (BNL-4856)

The existence of a (0.65 ± 0.25)% K-electron capture branch in the decay of 2.8-hr Sr^{87m} was established by means of an "internal source" technique. The low log ft = 4.25 and small energy release of 115 kev make this K branch especially interesting because it establishes Rb^{87} as a possible low-threshold detector for the inverse neutrino capture reaction, $Rb^{87} + \nu \rightarrow Sr^{87m} + e^-$, which could be identified by observing the characteristic decay of the Sr^{87m} isomer. (auth)

3448 RECOIL PROPERTIES OF FISSION PRODUCTS. John M. Alexander and M. Frances Gazdik (Univ. of California, Berkeley). Phys. Rev. 120, 874-86(1960) Nov. 1. (UCRL-8978 and Rev.)

The range and relative rates of energy loss in aluminum and gold were measured radiochemically for five products from thermal-neutron-induced fission of U^{235}. Range-velocity relationships for the median light product of fission and the median heavy product were obtained from these measurements and other energy-loss data. The relation of range (R) to energy (E) or velocity (V) can be fitted to functions of the form $R = kV - \Delta$ or $R = KE^{\frac{1}{2}}$. It was assumed that these functional forms can be applied to fission products of any mass. The constants K and Δ were determined from values of the range and kinetic energy for products of high yield. The values of these constants were extrapolated to products of low yield. Kinetic energies, heretofore unmeasured, were estimated from the ranges of low-yield products. Certain radiochemical observations were interpreted in terms of the average component of the range perpendicular to the original velocity. The value of this component in gold was estimated to be about one-fifth the total range. (auth)

3449 ABSOLUTE MEASUREMENT OF THE $T^3(p,n)He^3$ REACTION THRESHOLD ENERGY AND THE NEUTRON-HYDROGEN MASS DIFFERENCE. R. O. Bondelid (U. S. Naval Research Lab., Washington, D. C.), J. W. Butler, C. A. Kennedy, and Achilles del Callar. Phys. Rev. 120, 887-9(1960) Nov. 1.

The threshold energy of the $T^3(p,n)He^3$ reaction was precisely measured with a 2-meter radius electrostatic analyzer, calibrated by absolute methods. A clean tritiated zirconium target, protected from vacuum-system contaminants, was bombarded by protons having energy inhomogeneities as low as 0.02%. The result, obtained by an extrapolation of (net neutron counts)$^{\frac{1}{2}}$, gives a threshold value of 1019.7 ± 0.5 kev, a reaction Q value of −764.3 ± 0.4 kev, and a neutron-hydrogen mass difference of 782.9 ± 0.4 kev. (auth)

3450 ABSOLUTE DETERMINATION OF THE $O^{16}(d,n)F^{17}$ THRESHOLD ENERGY. R. O. Bondelid, J. W. Butler, and C. A. Kennedy (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev. 120, 889-90(1960) Nov. 1.

The threshold energy of the $O^{16}(d,n)F^{17}$ reaction was measured in an absolute manner with a two-meter radius electrostatic analyzer. The value obtained from the intercept of the plot of (net neutron counts)$^{\frac{1}{2}}$ as a function of bombarding energy is 1829.2 ± 0.6 kev. This threshold energy gives a reaction Q value of −1.6246 ± 0.0005 Mev, a F^{17} mass of 17.0074990 ± 0.0000032 amu, and a mass excess of 6.9828 ± 0.0030 Mev. (auth)

3451 MEASUREMENT OF THE $O^{16}(n,p)N^{16}$ CROSS SECTION AT 14.7 MEV. James A. DeJuren and Robert W. Stooksberry (Westinghouse Electric Corp., Pittsburgh). Phys. Rev. 120, 901-5(1960) Nov. 1.

The $O^{16}(n,p)N^{16}$ cross section was measured for 14.7-Mev neutrons. A recoil proton telescope was used to measure the neutron flux. Oxygen was incorporated in a liquid scintillator which was irradiated in the flux. The absolute activity of the resulting N^{16} was measured by $4\pi\beta$ counting the solution with two photomultipliers in coincidence. A value of 39.2 ± 1.6 mb was obtained for the cross section. (auth)

3452 COMPARISON OF Po^{210} ALPHA-PARTICLE ENERGY WITH THE $Li^7(p,n)Be^7$ REACTION THRESHOLD ENERGY. C. P. Browne, J. A. Galey, J. R. Erskine, and K. L. Warsh (Univ. of Notre Dame, Ind.). Phys. Rev. 120, 905-13(1960) Nov. 1.

Recent absolute measurements of the Po^{210} α-particle energy disagree with the older value used as the standard for many nuclear reaction energy measurements. A new comparison with the $Li^7(p,n)Be^7$ reaction threshold energy was made using the Notre Dame electrostatic accelerator and broad-range spectrograph. Four separate methods of comparison were used. In the first three the threshold was run and then protons or deuterons were scattered from appropriate targets so that the scattered group was recorded on the spectrograph plate near the α group from a source placed at the target position. First, the spectrograph and, second, the beam analyzer were used to compare particle momenta. Third, with both fields held constant after the threshold was run with the molecular beam, deuterons were scattered, giving particles of the same Bρ as the α's. In the fourth method several reaction energies that are precisely known in terms of the $Li^7(p,n)Be^7$ reaction threshold energy were measured in terms of the Po^{210} α-particle energy. These were the $Mg^{24}(d,d')Mg^{24*}$ reaction to the first excited state of Mg^{24} and the $N^{14}(d,p)N^{15}$ reaction leading to three excited states of N^{15}. The four measurements agree and give 5.3086 ± 0.003 Mev for Po^{210} α-particle energy based on 1.8811 Mev for the $Li^7(p,n)Be^7$ reaction threshold energy. (auth)

3453 NUCLEAR ENERGY LEVELS OF N^{17}, O^{18}, AND O^{20}. Nelson Jarmie and M. G. Silbert (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 120, 914-19(1960) Nov. 1.

The reactions $O^{18}(t,\alpha)N^{17}$, $O^{18}(t,p)O^{20}$, and $O^{18}(t,p)O^{20}$ were studied with a 180° double-focusing magnetic spectrometer. The measured energy levels of N^{17} up to 4.3 Mev are at 1.374, 8.851, 1.906, 2,536, 3.132, 3.212, 3.652, and 4.010 Mev. The measured energy levels of O^{18} up to 5.2 Mev are at 3.560, 3.639, 3.925, 4.457, and 5.084 Mev. The measured energy levels of O^{20} up to 4.6 Mev are at 1.682, 4.091, and 4.449 Mev. Standard deviations of 15 to 25 kev were assigned to these excitation energies. The Q value for $O^{18}(t,\alpha)N^{17}$ was determined to be 3.872 ± 0.015 Mev, which leads to a mass for N^{17} of 17.013856 ± 0.000017 amu. The Q value for $O^{18}(t,p)O^{20}$ was determined to be 3.086 ± 0.015 Mev, which leads to a mass for O^{20} of 20.010430 ± 0.000017 amu. Reaction cross sections at 30° lab angle and 2.6-Mev triton energy are presented for each level. (auth)

3454 ATOMIC BEAM STUDY OF THE HYPERFINE STRUCTURE OF THULIUM-170. Amado Y. Cabezas and Ingvar Lindgren (Univ. of California, Berkeley). Phys. Rev. 120, 920-5(1960) Nov. 1. (UCRL-9163)

The atomic-beam magnetic-resonance technique was

used to measure atomic and nuclear quantities of the 129-day isotope Tm^{170} as follows: $J = 7/2$, $g_J = 1.14122 \pm 0.00015$, $I = 1$, $|A| = 200 \pm 3$ Mc/sec, and $|B| = 1010 \pm 15$ Mc/sec. The values of J and g_J are consistent with the ground-state assignment $^2F_{7/2}$. Values of the nuclear moments are calculated from the hyperfine-structure interaction constants A and B by use of a two-parameter radial wave function, in which one parameter is determined from comparison with Hartree functions and the other parameters from the experimental spin-orbit coupling constant. Uncorrected values are obtained as follows: $|\mu_I| = 0.26 \pm 0.02$ nm and $|Q| = 0.61 \pm 0.05$ barn, with the two moments of the same sign. The same wave function is used to calculate the relativistic and diamagnetic corrections to the atomic g value, and the result is in excellent agreement with the experiment. (auth)

3455 PREFORMATION FACTOR IN EMISSION OF COMPLEX PARTICLES FROM NUCLEAR REACTIONS. Bernard L. Cohen (Univ. of Pittsburgh). Phys. Rev. 120, 925-7(1960) Nov. 1.

The reason why complex particles (α's, tritons, Li^6 nuclei, etc.) are emitted in nuclear reactions as frequently as nucleons (after corrections for Coulomb barrier penetration and energetics), whereas ice crystals are never emitted from evaporating water droplets, is investigated. It is shown that the difference is entirely explained by the fact that a nucleus is a highly degenerate system subject to Fermi-Dirac statistics, whereas an evaporating water droplet is a nondegenerate statistical system. (auth)

3456 jj COUPLING MODEL IN ODD-ODD NUCLEI. M. H. Brennan and A. M. Bernstein (Princeton Univ., N. J.). Phys. Rev. 120, 927-33(1960) Nov. 1. (PUC-196-14)

An analysis was made, using the jj coupling model, of the spins of 76 low-lying levels of odd-odd nuclei with $20 < A < 120$. Levels were excluded from the analysis if any ambiguity exists in the assignment of a configuration. Excluding particle-hole configurations Nordheim's "strong" rule was obeyed in the 22 cases in which it was applicable. Nordheim's "weak" rule was replaced by a rule predicting a ground state of the highest or lowest allowable spin. This revised rule was obeyed in 38 out of 41 cases. This competition between two levels of greatly differing spin results in the frequent occurrence of isomerism. For particle-hole configurations the state of the highest spin minus one is the ground state in 6 out of 13 cases. This agreement with experiment is obtained using proton and neutron configurations which, in 66 of the 76 cases, are found as ground states in the neighboring odd-even nuclei. The three revised coupling rules are predicted by the calculations of Schwartz, in which the residual proton-neutron interaction has a Δ-function radial dependence, if the singlet-to-triplet strength is taken as 0.6, independent of mass number. This value is the same as that required to fit the free two-nucleon data. Exceptions to the empirical coupling rules and this theory are discussed. (auth)

3457 ISOMERS OF Am^{242}. F. Asaro, I. Perlman, J. O. Rasmussen, and S. G. Thompson (Univ. of California, Berkeley). Phys. Rev. 120, 934-43(1960) Nov. 1. (UCRL-9047)

New measurements on the Am^{242} isomers show that the 16-hr activity is the ground state and the 152-year activity the upper isomer, contrary to earlier evidence. By electrostatic collection techniques some 16-hr americium activity was separated from an aged sample containing the 152-year isomer. Careful study of the conversion electron spectrum of the sample containing 152-year Am^{242m} revealed eleven conversion lines of a 48.6-kev transition converted in americium, and the relative M-subshell conversion intensities are only consistent with an E4 assignment. This information, coupled with the recent atomic beam measurement of spin 1 for the 16-hr activity, leads to a spin assignment of 5 for Am^{242m}. The experimental information on these isomers is given a detailed analysis in terms of the Bohr-Mottelson model. The most surprising conclusion of this analysis is that the spin 1 ground state has a K-quantum number of zero, and hence a negative spectroscopic quadrupole moment. Data on levels and decay of the low spin isomers of Ho^{166} and Ta^{180} are considered and lead to the conclusion that there is generally an energy displacement, between odd and even spin members of K = 0 rotational bands in odd-odd spheroidal nuclei. (auth)

3458 RARE E2 TRANSITION IN C^{13}. R. E. Pixley, J. V. Kane, and D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 943-5(1960) Nov. 1. (BNL-4875)

By means of a coincidence method it is shown that the $5/2^+$ state of C^{13} at 3.86 Mev has an E2 branch of relative strength $(9.3 \pm 2.0) \times 10^{-3}$ to the $1/2^+$ state at 3.09 Mev. From consideration of the likely strengths of the competing E1 transition to the $3/2^-$ state at 3.68 Mev and the M2 transition to the ground state it is deduced that this branching ratio implies an E2 transition speed of the order of a single-particle (proton) unit. This in turn demands the substantial participation of at least one excited state of C^{12} in the parentage of at least one of the C^{13} states with respect to the 1d or 2s neutron. This eliminates in particular a jj-coupling description of C^{13} in which the two states in question are $1d_{5/2}$ and $2s_{1/2}$ neutron states and more generally a weak-coupling model in which the ground state of C^{12} is the unique parent for the C^{13} states (with respect to 1d and 2s neutrons). (auth)

3459 NUCLEAR ORIENTATION OF Mn^{54} AND Mn^{52m}. Rudolf W. Bauer, Martin Deutsch, Gordon S. Mutchler, and Donald G. Simons (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 120, 946-51(1960) Nov. 1.

The spins of the nuclides Mn^{54} (290 days) and Mn^{52m} (21 min), incorporated in the lattice of cerium magnesium nitrate and nickel fluosilicate crystals, were oriented at low temperatures. The measurement of the angular distribution of the γ rays from Mn^{54} indicates the spin of Mn^{54} to be 3 or 2; in the latter case, the β decay must be predominantly of the Fermi type with an upper limit of 10% of a possible Gamow-Teller admixture. From a simultaneous measurement of the angular distribution of the γ rays from Mn^{54} and 5.7-day Mn^{52} the ratio of the nuclear g values of the two isotopes is found, which yields a magnetic moment for Mn^{54} of 2.55 ± 0.21 nm (for spin 3) or 2.16 ± 0.26 nm (for spin 2). The circular polarization measurements of the γ rays from Mn^{54} determine this moment to be positive. Similar angular distribution experiments on Mn^{52m}, assuming spin 2, yield a magnetic moment of 1.04 ± 0.16 nm if the β decay is predominantly a Gamow-Teller transition, or 0.72 ± 0.16 nm for a pure Fermi transition. These results indicate that the nuclear g values of the 21-min and the 5.7-day states of Mn^{52} are about the same. (auth)

3460 RADIATIVE CAPTURE OF PROTONS BY F^{19} AT A BOMBARDING ENERGY OF 669 kev. J. V. Kane, R. E. Pixley, and D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 952-7(1960) Nov. 1. (BNL-4874)

The ground-state transition from the 13.51-Mev state of

Ne^{20} formed by bombarding fluorine with protons of 669 kev is anomalously weak. This is interesting because the 13.51-Mev state has a large reduced width for proton emission to the ground state of F^{19} and a large M1 width for radiation to the first excited (1.63-Mev) state of Ne^{20}. A simple explanation would be that the ground state of Ne^{20} is close to $(2s_{1/2})^4$. The ground-state radiation is sought and found using a 3-in. × 3-in. NaI(Tl) crystal. The radiative width is $\sim 1.0 \times 10^{-2}$ ev corresponding to $|M|^2 \sim 2 \times 10^{-4}$. The 13.51-Mev state is found to radiate to the 4.97-Mev state with a width of ~0.24 ev. The 4.97-Mev state itself chiefly cascades via the first excited state: An upper limit on the relative strength of the ground-state transition is 0.07. (auth)

3461 EXTENSION OF THE SHELL MODEL FOR HEAVY SPHERICAL NUCLEI. Michel Baranger (Carnegie Inst. of Tech., Pittsburgh, Penna.). Phys. Rev. 120, 957-68(1960) Nov. 1.

The Bardeen-Bogoliubov-Belyaev treatment of the pairing correlations is applied to spherical nuclei with a general nuclear force. The interaction between quasi-particles is treated by the method of linearized equations of motion. An advantage of this treatment is that the same equations describe single-particle excitations and collective excitations, so that the former are orthogonal to the latter and the total number of states is correct. Another advantage is that the spurious states due to the fluctuations in the number of particles are automatically eliminated. The equations to be solved resemble those for a two-body shell model calculation. Simple estimates, based on Δ-function or quadrupole forces, are made for the vibrational frequencies in various modes and transition matrix elements. It is concluded that the method is as powerful as other known methods for dealing with collective states by the shell model, and that the same order of magnitude for the effective nuclear force seems capable of fitting all the data. (auth)

3462 APPROXIMATE CALCULATION OF NUCLEAR BINDING ENERGY. Leonard S. Rodberg and Vigdor L. Teplitz (Univ. of Maryland, College Park). Phys. Rev. 120, 969-76(1960) Nov. 1.

The binding energy, size, and shape of finite nuclei are studied using a method which tests the "local uniformity" assumption. This assumption implies that the properties of finite nuclei can be obtained from those of infinite nuclear matter. The energy is computed using as a trial wave function an amplitude- and frequency-modulated plane wave; this permits the use of nuclear-matter results in a straightforward manner. The calculation gives a binding energy which is too low, a radius which is too small, and a nuclear surface which is too diffuse. Several possible corrections to this result are examined. (auth)

3463 NEW NUCLIDE, KRYPTON-74. J. H. Gray, III, H. L. Hamester, and A. A. Caretto, Jr. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 120, 977-9(1960) Nov. 1.

A new nuclide of krypton, Kr^{74}, was produced by high-energy proton interaction with strontium. It was found to have a half life of (20 ± 1) min and to decay by (3.1 ± 0.1)-Mev positrons. No γ rays in the energy range 0.04 to 4.0 Mev were observed. Evidence for the production of Kr^{75} was observed. Calculations indicate an upper limit for the half life of (0.8 ± 0.4) min. (auth)

3464 RADIOACTIVE DECAY OF Lu^{170}. R. G. Wilson and M. L. Pool (Ohio State Univ., Columbus). Phys. Rev. 120, 980-2(1960) Nov. 1.

Ytterbium oxide enriched to 81.4% in the 170 mass number was irradiated with 6-Mev protons. An activity decaying by electron capture with a half life of (2.05 ± 0.05) days was produced and assigned to Lu^{170} by the identification of the ytterbium K x ray and by comparison with the activities produced by similar proton irradiations of each of the other enriched isotopes of ytterbium. The observed activity consists of the ytterbium K x ray, γ rays with energies of 84, 193, 245, 1010, 1030, 1165, 1275, 1415, 2035, 2365, 2665, 2890, and 3085 kev, and a small amount of annihilation radiation. Because no particle radiation exists, the mode of decay of Lu^{170} is solely by electron capture to Yb^{170}. γ-γ coincidence measurements have led to the postulation of levels in Yb^{170} at 2120 (0), 2365 (1 or 2), 3170 (3), and 3395 (1 or 2) kev, in addition to the previously assigned 84 (2+) and 278 (4+) levels. A partial energy level scheme with approximate electron capture branching ratios is proposed. (auth)

3465 QUENCHING OF MAGNETIC MOMENTS IN NUCLEI. S. D. Drell and J. D. Walecka (Stanford Univ., Calif.). Phys. Rev. 120, 1069-78(1960) Nov. 1.

Starting from the premise that with modern dispersion-theoretical techniques, a reliable method is made available for calculating the anomalous magnetic moment of a nucleon, the modification or "quenching" of this moment for a nucleon in nuclear matter was calculated. The effect considered here is caused by the fact that nucleons are not allowed by the exclusion principle to recoil into states already occupied by other nucleons in the nucleus. The actual technique used in this calculation is to sum all the Feynman diagrams that are included in the dispersion-theory calculation of the single-nucleon moment. Then the nucleon propagator is written as a sum over states and those states are removed in which the nucleon is inside the Fermi sea. The result is that the anomalous moment is reduced by ≈7%. (auth)

3466 RESONANCE ABSORPTION OF NUCLEAR GAMMA RAYS AND THE DYNAMICS OF ATOMIC MOTIONS. K. S. Singwi and A. Sjölander (Argonne National Lab., Ill.). Phys. Rev. 120, 1093-1102(1960) Nov. 15.

The theory of resonance absorption of nuclear γ rays is generalized for an arbitrary system of interacting particles by expressing the relevant transition probability in terms of a space-time self-correlation function; thus relating the resonance line shape to the incoherent differential scattering cross section for slow neutrons. Two limiting cases, a gas and a solid, were considered. Discussion regarding the justification of the use of a classical self-diffusion function for a liquid is given, and expressions for the broadening of the resonance line due to diffusive motions of the atoms of the interacting system are derived. It is suggested how Mössbauer-type experiment could be used to give information regarding the diffusive motions of atoms in a solid and also, under more favorable circumstances, in a liquid. (auth)

3467 NUCLEAR SPIN RELAXATION IN LIQUID HELIUM 3. F. J. Low and H. E. Rorschach (Rice Univ., Houston, Tex.). Phys. Rev. 120, 1111-19(1960) Nov. 15.

The longitudinal relaxation time of liquid He^3 was measured as a function of temperature above 1°K and of magnetic field below 13 kgauss in a number of sample containers. At a temperature of 2.0°K and in a magnetic field of 10 kgauss the longitudinal relaxation time, T_1, varied with the sample container from 60 to 400 sec. The transverse relaxation time, T_2, was measured by a new method and was approximately 30 sec at a field of 10 kgauss in all sample containers. T_1 was determined as a function of magnetic

field at 2.0°K in a single sample container; the values increased from less than 50 sec in approximately zero field to 400 sec at 13 kgauss. An impurity relaxation model is proposed to explain the T_1 results. By assuming both wall relaxation and a bulk relaxation given by the Bloembergen, Purcell, and Pound theory, the dependence of T_1 on pressure and temperature can be quantitatively understood. The low values of T_2 are inconsistent with the Bloembergen, Purcell, and Pound theory and may be due to the presence of paramagnetic impurities in suspension in the bulk liquid. (auth)

3468 RADIOACTIVE DECAY OF Yb^{167}. R. G. Wilson and M. L. Pool (Ohio State Univ., Columbus). Phys. Rev. 120, 1296-7(1960) Nov. 15.

Erbium oxide enriched to 35.1% in the mass number 164 was irradiated with 17 and 24 Mev α particles. An activity decaying by electron capture with a half-life of (17.7 ± 0.2) min was produced and its assignment to Yb^{167} confirmed by the identification of the thulium K x ray and the well-known daughter activity of Tm^{167}. Gamma rays with energies of 106, 113, and 176 kev were observed in the spectrum of Yb^{167}. Gamma-gamma coincidence measurements were performed on the observed radiations. Transition probabilities, multipole order admixtures, and electron capture branching ratios were calculated. Approximately 89% of the electron capture transitions occurred to the 292.7-kev ($^7/_2-$) level of Tm^{167}. (auth)

3469 NUCLEAR DEFORMATION IN THE SPHEROIDAL SHELL MODEL. Kiuck Lee and D. R. Inglis (Argonne National Lab., Ill.). Phys. Rev. 120, 1298-1302(1960) Nov. 15.

In the usual shell-model procedure, the effective Hamiltonian contains only half the sum of the shell-model potentials of nucleons in order to avoid counting average pairwise interactions twice. Because of the factor one-half, the nondiagonal elements of this Hamiltonian in the harmonic oscillator representation do not vanish, but they were neglected in previous calculations of nuclear deformations by Nilsson and others, in which total shell-model energy at constant volume is minimized. It is shown that in typical cases (without taking spin-orbit coupling into account) the equilibrium deformation is unaltered in second and third order and that the fourth-order modification arising from the nondiagonal elements is very small. The relation of these nondiagonal elements to those of the pairwise interactions is also discussed. (auth)

3470 FINE STRUCTURE IN THE ENERGY SPECTRA OF PHOTOPROTONS FROM He^4. Carmelo Milone (Università, Catania, Italy and Centro Siciliano di Fisica Nucleare, Catania, Italy). Phys. Rev. 120, 1302-5(1960) Nov. 15.

The energy spectra of the photoprotons from He^4 irradiated with 31 and 32 Mev bremsstrahlung were studied by means of nuclear photoemulsions in ΔE_γ steps of 0.133 Mev. In the region of the giant resonance, several peaks were distinguished. The more evident of these have widths less than 0.5 Mev and are located at He^4 excitation energies of 24.7 ± 0.2 and 26.1 ± 0.1 Mev. Previous experiments on the photoproton spectra from He^4 could not give evidence of these narrow resonances because the spectra were examined in energy steps much larger than the width of these resonances. Other types of experiments that were performed in order to obtain information on the existence of excited states in He^4 are discussed. The fact that narrow resonances are distinguished only in the present experiment is attributable to the selective nature of the (γ,p) process, the most important contribution in the $He^4(\gamma,p)$ reaction coming only from the states of He^4 having $J = 1^-$ and $T = 1$. (auth)

3471 INTERPRETATION OF ISOMERIC CROSS-SECTION RATIOS FOR (n,γ) AND (γ,n) REACTIONS. J. R. Huizenga and R. Vandenbosch (Argonne National Lab., Ill.). Phys. Rev. 120, 1305-12(1960) Nov. 15.

The relative probability of forming each member of a pair of nuclear isomeric states was compared with theoretical predictions in order to learn which nuclear parameters can be determined from these data. For thermal neutron capture reactions, the observed ratios do not give much information about the dependence of the nuclear level density on spin, but they are consistent with a spin cutoff factor, $\exp[-(J + {}^1/_2)^2/2\sigma^2]$, where $\sigma \leq 5$. The calculations are sufficiently consistent with experiment to make their predictions usable as a guide for assigning spins to the compound states formed in thermal or resonant energy neutron capture. For (γ,n) reactions, the calculations reproduce the energy dependence of the experimentally observed isomeric cross-section ratios. In order to obtain quantitative information about the spin dependence of the nuclear level density, it is necessary to consider reactions where particles are emitted which can carry off enough angular momentum to reach many spin states of the residual nucleus. (auth)

3472 ISOMERIC CROSS-SECTION RATIOS FOR REACTIONS PRODUCING THE ISOMERIC PAIR $Hg^{197,197m}$. R. Vandenbosch and J. R. Huizenga (Argonne National Lab., Ill.). Phys. Rev. 120, 1313-18(1960) Nov. 15.

Excitation functions and isomeric cross-section ratios were determined for the $Au^{197}(p,n)$ and $Au^{197}(d,2n)$ reactions. Isomeric cross-section ratios were also determined for the $Hg^{196}(n,\gamma)$, $Hg^{196}(d,p)$, $Hg^{198}(n,2n)$, $Hg^{198}(\alpha,\alpha n)$, and $Pt(\alpha,xn)$ reactions. Those reactions for which compound nucleus formation predominates were treated by a statistical model. In this treatment the compound state was characterized by angular momentum and excitation energy. Analysis yielded a value of 4 ± 1 for the parameter σ, which characterized the dependence of the nuclear level density on angular momentum. Relatively small amounts of angular momentum were transferred in reactions that proceeded predominantly by a direct interaction mechanism. Such reactions, therefore, gave a larger yield of the isomer with spin closer to that of the target nucleus. (auth)

3473 $Ni^{58}(n,p)Co^{58}$ CROSS SECTION FOR NEUTRONS OF ENERGIES BETWEEN 2.2 AND 3.6 MEV. L. González, J. Rapaport, and J. J. van Loef (Universidad de Chile, Santiago). Phys. Rev. 120, 1319-21(1960) Nov. 15.

The relative cross section for $Ni^{58}(n,p)Co^{58}$ was measured by an activation method for neutron energies of 2.2 to 3.6 Mev. The absolute cross section at 3.55 Mev neutron energy was found to be 195 ± 30 mb by comparing the intensity of the 810 kev γ ray of Co^{58} with the amount of Si^{31} formed in the $P^{31}(n,p)Si^{31}$ reaction, which has a previously known cross section of 96.2 ± 9.0 mb. The cross section rose from 140 mb at 2.2 Mev to a maximum value of 214 mb at 3.0 Mev. Observed cross sections were compared with the predictions of the statistical theory of nuclear reactions by using a square well potential and a diffuse edge potential. In neither case could a satisfactory agreement with experimental data be obtained. (auth)

3474 LIFETIMES OR ROTATIONAL LEVELS IN SOME ODD-A NUCLEI MEASURED BY A MICROWAVE METHOD. A. E. Blaugrund, Y. Dar, and G. Goldring (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. 120, 1328-40(1960) Nov. 15.

Measurements of mean lives of the first excited states of a number of odd-A nuclei were carried out with the intention of obtaining more accurate information on magnetic transition probabilities than is at present available. Most of these mean lives were in the range of $2 - 20 \times 10^{-11}$ sec, and for this measurement a special timing apparatus was devised which consisted of a microwave beam pulsing system and a beta spectrometer and cavity combination which acted as a microwave shutter. In four cases the exponential decay could be determined directly; these were the first excited states of Lu^{175}, Hf^{179}, and Ta^{181}, and the 118-kev level of Tm^{169}. The results for these levels are: $\tau(Tm^{169}) = (9.0 \pm 0.4) \times 10^{-11}$ sec, $\tau(Lu^{175}) = (14.6 \pm 1) \times 10^{-11}$ sec, $\tau(Hf^{179}) = (5.4 \pm 0.4) \times 10^{-11}$ sec, and $\tau(Ta^{181}) = (6.0 \pm 0.5) \times 10^{-11}$ sec. Lifetime measurements were also carried out for the first excited states of Hf^{177}, Re^{185}, and Re^{187}. The limitations and scope of this method of measuring lifetimes are discussed. (auth)

3475 FISSION OF GOLD BY CARBON IONS. Glen E. Gordon, Almon E. Larsh, Torbjørn Sikkeland, and Glenn T. Seaborg (Univ. of California, Berkeley). Phys. Rev. 120, 1341-8(1960) Nov. 15. (UCRL-9257)

Angular distribution and kinetic-energy spectra of fragments, and cross sections for fission of gold with 68 to 124 Mev C^{12} ions were obtained by observation of the fragments in two types of detectors (gas scintillation chambers and silicon p-n junctions). From the parameters used to fit the angular distributions to the theoretical curves of Halpern and Strutinski, the average excitation energy of the fissioning nucleus at the time of fission was obtained. This quantity is approximately 25 Mev, which is nearly independent of bombarding energy, suggesting that fission is preceded by the emission of several particles from the compound nucleus. The fission cross section increased from a value of 100 mb at 68 Mev to 1.28 b at 124 Mev. Over this range of bombarding energies, the total fragment kinetic-energy release rose from 142 ± 6 to 146 ± 6 Mev. At all bombarding energies, the variation of laboratory-system kinetic energy of the fragments with laboratory-system angle indicated full-momentum transfer by the bombarding particle to the fissioning system. (auth)

3476 DISINTEGRATION OF Te^{119}. C. W. Kocher, Allan C. G. Mitchell, C. B. Creager, and T. D. Nainan (Indiana Univ., Bloomington). Phys. Rev. 120, 1348-53(1960) Nov. 15.

The disintegration of Te^{119} was studied with the help of magnetic spectrometers and scintillation counters. Two half-lives were observed (one of 4.7 ± 0.3 days and one of ~16 hours). These represent the decay from two isomeric states. The isomeric transition was not observed because of the strong competition from the decay to states of Sb^{119} The 4.7-day disintegration occurred by electron capture and exhibited γ rays of the following energies: 0.153, 0.270, 0.930, 1.10, 1.22, and 2.12 Mev. The following coincidences were observed: (2.12, 0.270), (1.22, 0.930, 0.153), (1.10, 0.270). The K/(L + M) ratio for the line at 0.153 Mev was 7.85 and for the line at 0.270 Mev, 5.77. The 16-hr isomer exhibited positrons of end-point energy 0.627 Mev; and two γ rays of energy 1.76 and 0.645 Mev. A disintegration scheme is given. (auth)

3477 SURVEY OF TRITIUM-PRODUCING NUCLEAR REACTIONS. Jose Gonzalez-Vidal and William H. Wade (Univ. of California, Berkeley). Phys. Rev. 120, 1354-9 (1960) Nov. 15. (UCRL-9102)

(p,t), (d,t), and (α,t) reactions of all the elements that are listed in the periodic table were investigated by bombarding stacked metal foils and determining directly the tritium produced in the reaction. In the (α,t) reactions, there was conclusive evidence that most of the tritons are produced with high energies, thus indicating the presence of direct interaction processes. The curve representing the integrated cross section vs. Z of the target rose with decreasing Z. This and the appearance of low-energy peaks in the individual excitation functions of low-Z targets indicated that at low and intermediate values of Z, the relative number of low-energy tritons increased. These tritons were probably the product of a compound-nucleus mechanism. For the (p,t) and (d,t) reactions the same compound-nucleus and direct-interaction effects were noticed. (auth)

3478 SINGLE AND MULTIPLE STRIPPING OF α PARTICLES. M. el Nadi (Yale Univ., New Haven). Phys. Rev. 120, 1360-9(1960) Nov. 15.

Assuming the stripping process to take place mainly at the nuclear surface, expressions were derived for the differential cross sections for the processes in which one, two, or three nucleons are stripped from an incident α particle by the target nucleus. Comparison between the derived formulas and experimental data was carried out for the (He^3,p) and (α,p) reactions and shows fairly good agreement. (auth)

3479 ANGULAR DISTRIBUTIONS OF THE $Be^9(d,n)B^{10}$ NEUTRONS. Richard Bardes and George E. Owen (Johns Hopkins Univ., Baltimore). Phys. Rev. 120, 1369-74 (1960) Nov. 15.

The angular distributions of neutrons to the ground state and to the first excited state of B^{10} in the reaction $Be^9(d,n)B^{10}$ were studied at incident deuteron energies of 1.41, 1.88, and 2.35 Mev. A proton recoil spectrometer utilizing a xenon gas scintillation trigger was developed to study this problem. This spectrometer operated with a resolution of the order of 7% at the neutron energies involved in this reaction. Analysis of the data in terms of a direct interaction mechanism indicated that the results are consistent with an interpretation that indicates that the majority of the neutrons emitted at bombarding energies below the Coulomb barrier originate in the Be^9 target nucleus. (auth)

3480 INELASTIC DIFFRACTION SCATTERING. E. Rost and N. Austern (Univ. of Pittsburgh). Phys. Rev. 120, 1375-87(1960) Nov. 15.

The method of distorted waves Born approximation is shown to be equivalent to the first-order adiabatic method for the calculation of inelastic scattering. The flexibility of the distorted waves method was indicated and tested by numerical calculation for a simplified model. The calculations treated the inelastic scattering of α particles from strongly absorbing nuclei and were directly comparable to the adiabatic calculations considered by Blair in Fraunhofer approximation. Good agreement was found at forward angles. Coulomb wave functions were used, and the energy difference between initial and final states was taken into account. Comparison is made to a few representative experiments, and good agreement is found. (auth)

3481 CREATION OF THE HEAVY ELEMENTS BY NEUTRON CAPTURE ON A FAST TIME SCALE. Peter Fong (Utica Coll. of Syracuse Univ., N. Y. and Massachusetts Inst of Tech., Cambridge). Phys. Rev. 120, 1388-93 (1960) Nov. 15.

The mathematical problem concerning the creation of the heavy elements by neutron capture on a fast time

scale involves the solution of more than a thousand simultaneous differential equations. This set of equations was solved by replacing them with a mathematical equivalent—a single partial differential equation that turns out to assume the form of the equation of continuity. The stream lines of the analogous hydrodynamical problem were determined, from which the problem of nucleogenesis may be solved once the initial condition is given. By assuming a neutron capture mean lifetime of about 0.1 sec for all nonmagic-number nuclides and by making use of the fact that the neutron magic-number nuclides have smaller neutron-capture cross sections, the position, width, and height of the abundance peaks at Br, Xe, and Pt were determined. These agreed reasonably well with the experimental results. (auth)

3482 MOTT-SCATTERING ANALYSIS OF LONGITUDINAL POLARIZATION OF ELECTRONS FROM Co^{60}. J. S. Greenberg, D. P. Malone, R. L. Gluckstern, and V. W. Hughes (Yale Univ., New Haven). Phys. Rev. 120, 1393-1405(1960) Nov. 15.

Mott scattering was used to analyze the degree of longitudinal polarization of β particles emitted from radioactive nuclei. The reliability of this method and the influences of the various systematic errors associated with this method on the accuracy of the measurement were investigated in detail and are discussed. On the basis of a linear extrapolation of the inverse of the Mott asymmetry to zero scatterer thickness, the polarization of 194 kev electrons from Co^{60} was found to be $-(0.994 \pm 0.057)\,v/c$ with all known corrections applied. The effects of atomic screening and finite nuclear size were not included. Using the quoted value for the polarization measured in the pure Gamow-Teller transition in Co^{60} yields $C_A = (0.7 \text{ to } 1.45)C_{A'}$. (auth)

3483 NUCLEAR SPINS OF SIX NEUTRON-DEFICIENT GOLD ISOTOPES. W. Bruce Ewbank, Lawrence L. Marino, William A. Nierenberg, Howard A. Shugart, and Henry B. Silsbee (Univ. of California, Berkeley). Phys. Rev. 120, 1406-10(1960) Nov. 15. (UCRL-9211)

The nuclear spins of six neutron-deficient isotopes of gold were measured by atomic-beam magnetic-resonance methods. The results of these measurements are as follows: Au^{191}(3.0 hr), $I = 3/2$; Au^{192}(4.8 hr), $I = 1$; Au^{193}(17.5 hr), $I = 3/2$; Au^{194}(39 hr), $I = 1$; Au^{195}(190 day), $I = 3/2$; and Au^{196} (5.6 day), $I = 2$. (auth)

3484 DECAY SCHEME OF Dy^{159}. R. C. Greenwood and E. Brannen (Univ. of Western Ontario, London, Can.). Phys. Rev. 120, 1411-14(1960) Nov. 15.

The electron capture decay of Dy^{159} was shown to occur appreciably only to the 58-kev state and ground state of Tb^{159} with branching ratios of 37% and 63%, respectively. The K internal conversion coefficient of the 58-kev transition was measured as $\alpha_K = 8.5^{+0.7}_{-1.2}$, which is consistent with a predominantly M1 transition, with the possibility of some E2 mixing. The orbital electron capture ratio to the 58-kev state of Tb^{159} was obtained as $P_{LM}\ldots/P_K = 0.17 \pm 0.15$. From this value a minimum decay energy to the ground state of Tb^{159} was assigned as 230 kev. The upper limit on transitions to the 138-kev and 364-kev states of Tb^{159} was placed at 0.1%. A spin and parity of $3/2-$ was assigned to the ground state of Dy^{159} from a consideration of log ft values. An upper limit of 450 kev was placed on the decay energy to the ground state of Tb^{159}. (auth)

3485 PSEUDOSCALAR INTERACTION IN NUCLEAR BETA DECAY. C. P. Bhalla (Univ. of Tennessee, Knoxville), and M. E. Rose. Phys. Rev. 120, 1415-24(1960) Nov. 15.

The experiments on the allowed β transitions, which lead almost uniquely to the V−1.2A interaction, do not have any bearing on a possible contribution from the pseudoscalar interaction. To determine whether or not any contribution from the pseudoscalar interaction is really needed, an examination was made of the β longitudinal polarization and the β shape factor in the $0 \rightarrow 0$ beta transitions. The theoretical polarization for the mixture of the pseudoscalar and the axial vector interactions was developed. In this work, the formulation of the pseudoscalar interaction as given by Rose and Osborn was used. The numerical results on the β longitudinal polarization and the shape factor depend on two parameters, namely, the coupling constant ratio, C_p/MC_A, and λ, the ratio of the two relevant nuclear matrix elements. M is the nucleon mass in units of the electron mass. The electronic functions occurring in the theoretical formulas for these effects are tabulated for Pr^{144} ($0^- \rightarrow 0^+$) and Ho^{166} ($0^- \rightarrow 0^+$). All the electronic radial functions were computed considering the nucleus as a sphere of a uniform charge distribution with a nuclear radius as $1.2A^{1/3} \times 10^{-13}$ cm and taking into account the finite deBroglie wavelength effect. The results of extensive numerical analysis are presented. It was concluded that the absence of the pseudoscalar interaction is consistent with the existing experimental data. The value of C_p/MC_A, which also gives a satisfactory fit to the experimental data, depends on λ. The upper limit of the value of $|C_p/MC_A|$ is found to be 0.05 for $|\lambda| = 200$. Time-reversal invariance is assumed valid for the weak as well as the strong interactions, and the two-component theory of the neutrino was used. (auth)

3486 PHOTONEUTRON CROSS SECTIONS OF COBALT AND MANGANESE. P. A. Flournoy, R. S. Tickle, and W. D. Whitehead (Univ. of Virginia, Charlottesville). Phys. Rev. 120, 1424-8(1960) Nov. 15.

The total photoneutron yields of Mn^{55} and Co^{59} were measured from threshold to approximately 30 Mev. Analysis of these data using the Leiss-Penfold matrix indicated that the cross sections for both elements show a splitting in the giant resonance region in accord with the predictions of the classical hydrodynamic model. The Mn^{55} peaks occurred at energies of 16.8 ± 0.25 and 19.75 ± 0.25 Mev, corresponding to cross sections of 90 and 77 mb, respectively. Co^{59} maxima occurred at 16.75 ± 0.25 and 18.75 ± 0.25 Mev with cross sections of 109 and 92 mb. The cross sections $\sigma(\gamma,n) + \sigma(\gamma,2n) + \sigma(\gamma,np) + \ldots$ integrated to 25 Mev were 627 Mev-mb for Mn^{55} and 709 Mev-mb for Co^{59}. Breit-Wigner resonance lines were fitted to both cross sections and the intrinsic quadrupole moments determined from these fits were +0.78 ± 0.10 barn for manganese and +0.76 ± 0.11 barn for cobalt. (auth)

3487 HYPERFINE STRUCTURE OF AMERICIUM-241. Richard Marrus, William A. Nierenberg, and Joseph Winocur (Univ. of California, Berkeley). Phys. Rev. 120, 1429-35(1960) Nov. 15. (UCRL-9207)

Atomic-beam measurements on Am^{241} confirmed that the nuclear spin is $I = 5/2$ and established that the electronic ground state is characterized by an angular momentum $J = 7/2$ and a Landé splitting factor $g_J = -1.9371(10)$. In addition, the magnetic-dipole and electric-quadrupole hyperfine-structure coupling constants were found to be, respectively, $A = \pm 17.144(8)$ Mc/sec and $B = \pm 123.82(10)$ Mc/sec. It is hypothesized that these values arise from a state that is primarily formed from the Hund's rule term

^3S of the configuration $(5f)^1(7s)^2$. However, important contributions to the measured g_J, A, and B values are shown to come from the admixture of other terms in the ground state by means of the spin-orbit interaction and also from the excitation of s electrons in the core to higher s states. (auth)

3488 ENERGY LEVELS OF Ne^{21} AND Ne^{23}. Joan M. Freeman (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 120, 1436-41(1960) Nov. 15.

The energies of twenty-seven excited states of Ne^{21} and seventeen of Ne^{23} were established by a study of the (d,p) reactions in Ne^{20} and in Ne^{22}. Seven deuteron bombarding energies between 4.75 and 7.5 Mev were used, and the target was a cell with thin windows, containing either natural or Ne^{22}-enriched neon gas. The proton groups emitted at 90° were analyzed with a broad-range magnetic spectrograph. The established calibration of the spectrograph, in terms of α particles from polonium, together with some well-known reactions, provided the data necessary for precise energy determinations. The Q values obtained for the ground-state reactions $Ne^{20}(d,p)Ne^{21}$ and $Ne^{22}(d,p)Ne^{23}$ were 4.534 ± 0.009 and 2.791 ± 0.009 Mev, respectively. Deuteron groups inelastically scattered from Ne^{20} and Ne^{22} were also observed. The higher energy groups were used in the calibration procedure; the lower energy groups gave the results 4.250 ± 0.008 and 3.356 ± 0.008 Mev for the second excited states of Ne^{20} and Ne^{22}, respectively. The interpretation of the level schemes of Ne^{21} and Ne^{23} in terms of the collective model was considered and is discussed briefly. (auth)

3489 DECAY OF BOUND MUONS. Victor Gilinsky and Jon Mathews (California Inst. of Tech., Pasadena). Phys. Rev. 120, 1450-7(1960) Nov. 15.

The decay rate of bound muons from the K shell was calculated for elements up to lead. The muon was represented by a relativistic wave function for a point nucleus with parameters adjusted for finite-nuclear-size effects. The outcoming electron was represented by a Sommerfeld-Maue wave function. The decay rate was found to be a monotonically decreasing function of the atomic number. An estimate of the error was obtained by comparing with an exact calculation for the lowest electron angular state. The spectrum and angular distribution of the electrons are presented. (auth)

3490 LIGHT IODINE ISOTOPES. N. G. Zaĭtseva, M. Ya. Kuznetsova, I. Yu. Levenberg, and V. A. Khalkin. Radiokhimiya 2, 451-7(1960). (In Russian)

The mass numbers and half lives of I^{117}, I^{118}, I^{119}, and I^{121} were determined by accumulating the daughter isotopes Sb^{117}, Te^{118}, Sb^{119}, and Te^{121}. The half lives of the iodines were found to be ~10 min, 17 ± 2 min, 21 ± 1 min, and 2.1 ± 0.1 hr, respectively. It was also found that Te^{119} has two half lives of 12 ± 1 hr and 4.25 days. (R.V.J.)

3491 THE g FACTOR OF THE 92-Kev LEVEL AND OTHER ANGULAR CORRELATION MEASUREMENTS ON Pm^{147}. E. Bodenstedt, H. J. Körner, F. Frisius, D. Hovestadt, and E. Gerdau (Universität, Hamburg). Z. Physik 160, 33-46(1960). (In German)

The gyromagnetic ratio of the 92 kev level of Pm^{147} was determined by a measurement of the 321 kev-92 kev angular correlation in an external magnetic field of 15,000 gauss. The result g = +1.42 ± 0.20 implies corrections for the paramagnetism of the 4f-electron shell and for a time dependent attenuation by internal fields. A new determination of the half life of the 92 kev level confirmed the known value. The half life of the 412 kev level was found to be $T_{1/2} \leqq 5 \cdot 10^{-10}$ s. The following angular correlations were measured: 321 kev-92 kev cascade $W(\Theta) = 1 - (0.087 \pm 0.008) \cdot P_2 - (0.001 \pm 0.003) \cdot P_4$, 441 kev-92 kev cascade $W(\Theta) = 1 + (0.065 \pm 0.010) \cdot P_2 - (0.010 \pm 0.015) \cdot P_4$, 400 kev-92 kev cascade $W(\Theta) = 1 - (0.022 \pm 0.008) \cdot P_2 - (0.002 \pm 0.009) \cdot P_4$, 277 kev-92 kev triple cascade $W(\Theta) = 1 + (0.0016 \pm 0.0027) \cdot P_2 - (0.002 \pm 0.003) \cdot P_4$, 277 kev-321 kev cascade $W(\Theta) = 1 + (0.0117 \pm 0.0025) \cdot P_2 - (0.0067 \pm 0.0033) \cdot P_4$, 120 kev-321 kev cascade $W(\Theta) = 1 - (0.029 \pm 0.011) \cdot P_2 - (0.031 \pm 0.012) \cdot P_4$, and 400 kev-198 kev cascade $W(\Theta) = 1 - (0.067 \pm 0.009) \cdot P_2 + (0.001 \pm 0.011) \cdot P_4$. The spins and multipolarities of different γ transitions are derived from these results. (auth)

3492 THE β SPECTRUM OF Tl^{204}. K. Egelkraut and H. Leutz (Universität, Heidelberg, Ger.). Z. Physik 160, 74-9(1960). (In German)

The β spectrum of Tl^{204} was measured with Tl^{204} impregnated NaI(Tl) crystals. The maximum β energy was found to be 761 ± 8 kev. The measured deviations from the statistical shape correspond with the theoretical shape factor for first unique forbidden transitions. A β transition into the 375 kev level of Pb^{204} could not be found. (auth)

3493 THE COULOMB ENERGIES OF LIGHT ATOMIC NUCLEI. J. Jänecke (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Z. Physik 160, 171-85(1960). (In German)

A compilation of the known data on Coulomb energy differences of isobaric doublets and isobaric triplets is given. Plots of the Coulomb energy differences vs. $\overline{Z}/A^{1/3}$ with $\overline{Z} = (Z_1 + Z_2)/2$ show an analogous shell structure behavior for the three series with $2\overline{Z} = A - 1$, A, and A + 1 ($T = 1, \frac{1}{2}$, and 1), i.e., discontinuities at the closed shells at A = 4, 16, and 40 and the closed subshell at A = 32 and oscillations mainly caused by Coulomb proton-proton pairing energy. A positive energy shift of the lowest states with T = 1 of all self-conjugate nuclei with A = 4n + 2 seems to be indicated by the experimental data. A semi-empirical formula is given that describes the data. (auth)

3494 THE ISOMERIC NUCLEI Yb^{169m}, Yb^{175m}, AND Yb^{177m}. K.-W. Hoffmann, I. Y. Krause, W.-D. Schmidt-Ott, and A. Flammersfeld (Universität, Göttingen, Ger.). Z. Physik 160, 201-12(1960). (In German)

Short-lived isomers of ytterbium were produced by neutron irradiation of enriched isotopes and were investigated with the aid of scintillation spectrometers. Yb^{169m} decays with a half life of $T_{1/2} = (46 \pm 2)$ sec emitting only L radiation. This decay is assumed to be the same as the E3-transition of 24 kev following the electron capture of Lu^{169}. Yb^{175m} [$T_{1/2} = (0.072 \pm 0.005)$ sec] emits γ rays of (495 ± 15) kev. The measured K-conversion coefficient $\alpha_{K495} = 0.24 \pm 0.04$ and the total conversion coefficient $\alpha_{495} = 0.6 \pm 0.3$ indicate the transition to be M3. Yb^{177m} [$T_{1/2} = (6.4 \pm 0.1)$ sec] decays by a cascade of two γ rays. The isomeric (228 ± 3) kev transition is followed by a (104 ± 1.5) kev radiation. The measured conversion coefficients are $\alpha_{K228} = 4.1 \pm 0.4$ and $\alpha_{228} = 6.5 \pm 0.5$ for the first transition and $\alpha_{K104} = 0.39 \pm 0.05$ and $\alpha_{104} = 0.51 \pm 0.05$ for the second, indicating a M3-E1 cascade. For the M3 transition, the measured coefficients agree well with those calculated for a nucleus of finite size, but they differ by a factor of 1.5 for the E1 transition. (auth)

3495 INVESTIGATION OF SECONDARY CAPTURE OF LITHIUM NUCLEI BY LEAD. Yung-Yu Pang, V. V. Kuznetsov, M. Ya. Kuznetsova, V. N. Mekhedov, and V. A.

Khalkin (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 527-35(1960) Sept. (In Russian)

The formation of astatine isotopes in lead under bombardment by 80 to 660 Mev protons, 75 to 370 Mev deuterons, and 210 to 810 Mev α particles was studied by a radiochemical method. The astatine isotopes were obtained as a result of secondary capture of over Coulomb lithium nuclei produced in fragmentations. The At^{211} yield under α particle bombardment reached 0.3 microbarn and was practically independent of the α particle energy. Under proton and deuteron bombardment, it increased with the particle energy, especially when the proton energy exceeded 400 Mev and attained a value of 0.2 microbarn at an energy of 660 Mev. The At^{211} yield was independent of the lead-target thickness for thicknesses ranging from 0.3 to 1.6 mm and decreased for thicknesses smaller than 0.3 mm. The production cross section was computed and the energy spectrum of the captured lithium fragments was estimated on the basis of the astatine yield from lead. The cross section for production of over Coulomb lithium fragments by 660 Mev protons is 3 to 6 millibarns. (auth)

3496 ENERGY DISTRIBUTION OF THE FRAGMENTS OF TRIPLE U^{235} FISSION. V. N. Dmitriev, L. V. Drapchinskiĭ, K. A. Petrzhak, and Yu. F. Romanov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 556-62(1960) Sept. (In Russian)

Data on the energy distribution of the fragments of triple U^{235} fission are presented. It is shown that the ratio of the triple to double fission probability does not depend on the ratio of the masses. Arguments are given that substantiate the relation $E_d = E_{tr} + E_\alpha$, where E_d and E_{tr} are the total energies of the double and triple fission fragments and E_α is the energy of the long range α particle. The mechanism of triple fission is discussed. (auth)

3497 CAPTURE BY F^{19}, P^{31} AND S^{32} NUCLEI. G. E. Vetyukhov, A. N. Prokof'ev, and S. V. Strodubtsev (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. 39, 563-5(1960) Sept. (In Russian)

A telescope consisting of two proportional counters and a scintillation counter was employed to study the energy and angular distributions of deuterons from the reactions $F^{19}(n,d)O^{18}$, $P^{31}(n,d)Si^{30}$, $S^{32}(n,d)P^{31}$, and $Ne^{20}(n,d)F^{19}$. The cross sections and angular distributions for transitions to the ground states of the O^{18}, Si^{30}, and P^{31} nuclei were derived. The total cross section for the reaction $Ne^{20}(n,d)F^{19}$ was estimated. The reduced transition widths were computed from Butler's theory. (auth)

3498 LONGITUDINAL POLARIZATION OF β ELECTRONS. P. E. Spivak and L. A. Mikaelyan. Zhur. Eksptl'. i Teoret. Fiz. 39, 574-83(1960) Sept. (In Russian)

The longitudinal polarization of β particles from P^{32}, In^{114}, Sm^{153}, Lu^{177}, Ho^{166}, and Au^{198} nuclei was measured at an energy of 300 to 340 Mev by Mott scattering (transformation of the longitudinal polarization into transverse). Differences up to 10% were detected in the degree of polarization of the investigated isotopes. It was also found that the absolute values of the polarizations lie in the range $-(0.86$ to $0.97)$ v/c. The error of the absolute measurements does not include possible inaccuracies of the theoretical computation relating the polarization to the scattering asymmetry. (auth)

3499 TWO-CASCADE γ-TRANSITION IN THE Nd^{144} NUCLEUS ACCOMPANYING THE CAPTURE OF THERMAL NEUTRONS. V. R. Burmistrov and V. P. Radchenko. Zhur. Eksptl'. i Teoret. Fiz. 39, 584-6(1960) Sept. (In Russian)

The γ radiation accompanying the capture of thermal neutrons by the Nd^{143} nucleus was investigated by the sum-coincidence method with scintillation counters. Four two-cascade γ transitions were determined. An energy-level scheme that includes the well-known 0.69 Mev level in the Nd^{144} nucleus is proposed. The corresponding states are identified according to the relative cascade intensities. (auth)

3500 LONGITUDINAL POLARIZATION OF β-ELECTRONS FROM Au^{198}. A. I. Alikhanov, G. P. Eliseev, and V. A. Lybimov. Zhur. Eksptl'. i Teoret. Fiz. 39, 587-8 (1960) Sept. (In Russian)

The ratio of the polarization of electrons from Au^{198} and Tm^{170} was measured for energies of 145 and 390 kev. At 145 kev this ratio was equal to 0.8 ± 0.05 and at 390 kev the value 1.07 ± 0.08 was obtained. (auth)

3501 ANALYSIS OF NUCLEAR INTERACTIONS OF $E \geq 10^{11}$ eV NUCLEONS IN PHOTOGRAPHIC EMULSIONS. E. G. Boos (Inst. of Nuclear Research, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 616-23(1960) Sept. (In Russian)

The experimental data on collisions between nucleons and photographic emulsion nuclei are compared with the various theories of multiple production of mesons in which the tunnel model was employed. (auth)

3502 POLARIZATION OF INTERNAL CONVERSION ELECTRONS EMITTED AFTER β-DECAY OF ORIENTED NUCLEI. I. S. Baikov. Zhur. Eksptl'. i Teoret. Fiz. 39, 624-32(1960) Sept. (In Russian)

The correlation of the polarization of conversion electrons and β particles emitted in the decay of oriented nuclei was considered. The calculation was carried out by taking into account the electric field of the nucleus. Formulas were derived for the angular distribution and longitudinal and transverse polarization of conversion electrons from any shell with an arbitrary multipolarity mixture. The numerical results for L_I, L_{II}, and L_{III} shells refer to M1 and E2 multipoles or their mixture and are represented in the form of tables of the b_{kq}^R coefficients. These coefficients also determine the polarization of conversion electrons emitted after β decay of nonoriented nuclei. The β particle and conversion electron correlation can be employed to verify the invariance of β interaction under time inversion. (auth)

3503 ON A RELATIVISTIC GENERAL THEORY OF REACTIONS. M. I. Shirokov. Zhur. Eksptl'. i Teoret. Fiz. 39, 633-8(1960) Sept. (In Russian)

The formulas of a relativistic general theory that express cross section and polarization in terms of phase shifts may assume a different form depending on the definition of the relativistic spin operator. However, in the rest system of the particle, the spin operators coincide. This permits one to express the general theory in a form that is the same for all equivalent definitions of the spin. (auth)

3504 ON THE GROUND STATES OF ATOMIC NUCLEI. [PART] I. M. Ya. Amus'ya (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. 39, 639-50(1960) Sept. (In Russian)

A variational principle was formulated and applied to a many-particle system with two-particle interaction. The wave function was chosen in a form that permitted pair correlation to be taken into account exactly. Equations

were obtained for one- and two-particle functions in the first approximation in the correlations. It is shown that they can easily be extended to the case of strong correlations and three-particle interactions. The results were applied to the case of so-called nuclear matter. The equations obtained were compared with those of Brueckner. (auth)

3505 RESONANCE SCATTERING OF γ-QUANTA ON THE Li^7 NUCLEUS. I. Sh. Vashakidze, T. I. Kopaleĭshvili, V. I. Mamasakhlisov, and G. A. Chilashvili (Tbilisi State Univ., Academy of Sciences, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 666-8(1960) Sept. (In Russian)

Correlation functions for resonance scattering of γ quanta involving the excitation of the $5/2^-$ (7.46 Mev) level of the Li^7 nucleus were derived for one-particle and rotational excitation. The lifetime of the $1/2^-$ state (0.477 Mev) of the nucleus was also determined. (auth)

3506 POLARIZATION OF INTERNAL CONVERSION ELECTRONS AND POSITRONS EMITTED AFTER β-DECAY OF THE NUCLEUS. G. A. Lobov. Zhur. Eksptl'. i Teoret. Fiz. 39, 684-8(1960) Sept.

The correlation between the direction of emission of internal conversion electrons and positrons and the direction of emission of β particles from the preceding β-decaying nucleus is considered. Calculations were made for allowed β transitions without taking into account the Coulomb field of the nucleus (in the Born approximation) under some very general assumptions regarding the β-interaction Hamiltonian. The expressions obtained refer to arbitrary 2^j-pole electric and magnetic types of nuclear conversion transitions. The case of VA types of β coupling (with time parity being conserved) is considered, as well as the case of β transitions involving a change by unity of the nuclear spin, $\Delta I = \pm 1$ ($\Delta T = \pm 1$). A numerical computation is carried out on the polarization of internal conversion electrons emitted after β decay of the Na^{24} nucleus. (auth)

3507 CONTRIBUTION TO THE THEORY OF UNSTABLE STATES. Ya. B. Zel'dovich. Zhur. Eksptl'. i Teoret. Fiz. 39, 776-80(1960) Sept.

A perturbation theory was developed, and an expression of the amplitude for given initial state is presented for a state that decays exponentially. A finite expression was obtained that plays the role of the norm of such a state. (auth)

3508 ANGULAR DISTRIBUTION OF FISSION FRAGMENTS PRODUCED BY LOW ENERGY NEUTRONS. V. M. Strutinskiĭ. Zhur. Eksptl'. i Teoret. Fiz. 39, 781-93(1960) Sept.

The angular distribution of fission fragments produced in the capture of low orbital momentum particles was considered. The spin of the target nucleus was taken into account. The effect of fluctuations of the transition nucleus levels distribution on the angular distribution of the fission fragments also was considered. (auth)

3509 EQUATIONS FOR THE MANDELSTAM SPECTRAL REPRESENTATION FUNCTIONS. K. A. Ter-Martirosyan. Zhur. Eksptl'. i Teoret. Fiz. 39, 827-40 (1960) Sept.

On the basis of unitarity conditions, a closed equation set was derived for the Mandelstam spectral representation functions which is completely symmetric with respect to the three channels of the four particles vertices. The consistency of the equations that follow from the unitarity conditions in various channels is examined. If the integral representation is written with subtraction, a set of coupled equations for the spectral functions which depend on one and two variables is obtained. Consistent iteration of the equations obtained corresponds to taking into account the contribution (or part of the contribution) from a number of Feynman graphs consisting of two parts connected by two lines. The equation set goes over to one of the Chew–Mandelstam type if terms containing spectral functions depending on two variables are neglected. (auth)

3510 ELECTRIC MONOPOLE TRANSITIONS IN THE THEORY OF NONAXIAL NUCLEI. V. S. Rostovskiĭ (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 854-8 (1960) Sept.

It was demonstrated that if the coupling between rotation and β vibrations is taken into account, electric monopole transitions become possible between nuclear rotational states possessing the same moments and parities. The transition matrix elements between such states were calculated. The results were compared with experiments. (auth)

3511 THE INFLUENCE OF THE NUCLEAR RECOIL EFFECTS ON THE CROSS SECTION OF γ RAY RESONANCE SCATTERING ON Ni^{60} NUCLEI. D. A. Kaipov and Yu. K. Shubnyi (Inst. of Nuclear Research, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 888-9(1960) Sept.

Resonance scattering of 1330 kev γ rays, using gaseous and liquid sources of Co^{60} combined with CoCl, was studied. A strong effect was observed with the liquid source ($CoCl_2$ in HCl; ~40 mc activity). The self-absorption method ($1.14 \pm 0.37 \times 10^{-12}$ sec) was used for determining τ_γ. The resonance-scattering cross section for a liquid source is $(1.73 \pm 0.2) \times 10^{-27}$ cm^2. Considering the nuclear recoil rate 7.2×10^5 cm/sec and $\sigma_i/\sigma_2 = 9.9$, the value $\underline{1}$, the recoil nucleus range before interaction, is 8×10^{-3} cm. The variation of $\underline{1}$ due to recoil rate is negligible. (R.V.J.)

3512 NUCLEAR ZEEMAN EFFECT IN Sn^{119}. N. N. Delyagin, V. S. Shpinel, V. A. Bryukhanov, and B. Zvenglinskiĭ (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 894-6(1960) Sept.

The resonance absorption of 23.8 kev γ quanta by Sn^{119} was studied as a function of source intensity. The absorber was located in a constant external magnetic field, and Zeeman spallation appeared in the absorption line. The hyperfine absorption spectra permit the determination of the 23.8 kev magnetic moment of Sn^{119} in the excited state. A tin foil (94% Sn^{118}), irradiated by thermal neutrons in a reactor, was used as γ quantum source; an absorber (20 mg/cm^2 $SnNb_3$) was placed between magnetic poles forming a constant, uniform, 12150 gauss field. The measurements were carried out with and without a magnetic field. The results are plotted, and the distance Δ between the hyperfine structure components was found to be $(1.2 \pm 0.2) \times 10^{-7}$ ev, in good agreement with published data. For the 23.8 kev excited state, the nuclear magneton magnitude is $\mu = +(1.9 \pm 0.4)$. The result is considerably higher than that predicted by a single particle model, indicating that the 23.8 kev level in Sn^{119} is not a monomial and confirming that the M1 transition at 23.8 kev is 1-forbidden. (R.V.J.)

3513 PHYSIQUE NUCLÉAIRE. (Nuclear Physics). Michel Bayet. Pairs, Masson et Cie, 1960. 404p.

A physics textbook presented in three parts: Theoretical Physics, Constitution of Matter-Radioactivity, and Interactions of Nuclear Particles with Matter. Part one deals with elements of statistical physics, particle interactions,

angular momentum and spin, and relativity. The second part has chapters on constitution of the nucleus, nuclear dynamics, generalities on radioactive transformations, and the three types of radioactivity. Part three discusses the properties of nuclear radiations, the detection of nuclear radiation, the neutron, and nuclear reactions—fission and fusion. (T.R.H.)

Particle Accelerators

3514 (AERE-GP/R-2252) AN ANALOGUE STUDY OF NON-LINEAR EFFECTS IN SPIRAL RIDGE PARTICLE ACCELERATORS. F. M. Russell. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Mar. 1957. 21p.

An electromechanical analog was constructed for simulating the motions of particles, restricted to movement in the median plane, in particle accelerators employing spirally ridged magnetic guiding fields. The existence of subharmonic resonances associated with nonlinear effects was demonstrated, together with the occurrence of reduced stability regions between the main resonances. Phase-space diagrams were employed for studying the particle motions as the amplitudes of oscillation were progressively increased, so that transitions from stable to unstable motions could be examined. A broad survey was made of the stability regions between the $\frac{1}{3}$ and $\frac{1}{8}$ subharmonic resonances, and the normalized results are displayed in graphic form. (auth)

3515 (BNL-5034) AGS EXPERIMENTAL MAGNET POWER SUPPLIES. J. G. Cottingham, E. A. Kessler, and A. V. Soukas. Brookhaven National Lab., Upton, N. Y. Aug. 22, 1960. 18p. (JGC/EAK/AVS-1). OTS.

The experimental magnet power supplies, consisting essentially of silicon diode rectification with magnetic amplifier control, were designed to supply power to the experimental equipment associated with the beam of the Alternating Gradient Synchrotron (AGS). This equipment includes deflecting magnets, quadrupole or focusing magnets, and electrostatic-electromagnetic beam separators. (W.L.H.)

3516 (CERN-60-38) THE EFFECT OF RADIO-FREQUENCY PROGRAMME NOISE ON THE PHASE-STABLE ACCELERATION PROCESS. H. G. Hereward and K. Johnsen. European Organization for Nuclear Research, Geneva. Oct. 4, 1960. 17p.

There are cases in which it may be impractical to obtain phase-error information from the particle bunches being accelerated. In a storage ring or beam-stacking accelerator, the bunches may contain 1% of all the particles present, and the 99% in the stack are modulated azimuthally in density by the r-f and produce signals that cannot be distinguished from those due to the accelerating bunches. The effect of r-f program noise was studied in detail, with special reference to the electron beam-stacking model presently considered at CERN but with sufficient generality to be applicable to any circular machine in which acceleration is by r-f in bunches and without feedback of beam information. (W.D.M.)

3517 (DESY-A2.62) KORREKTUREN FÜR ENDEFFEKTE. (Corrections for End Effects). G. Ripken. Deutsches Elektronen-Synchrotron, Hamburg. May 4, 1960. 17p.

Calculations were made of the frequency shift and deformation of the closed orbit on the basis of the end-effects of the magnets. (T.R.H.)

3518 (DESY-A2.63) BERECHNUNG DER TEILCHENVERLUSTE DURCH DIFFUSION. (Calculation of Particle Loss by Scattering). Cord Passow. Deutsches Elektronen-Synchrotron, Hamburg. May 10, 1960. 20p.

Electrons with energies varying from the required energy produce oscillations at a potential whose shape is determined by the phase-oscillation equation. The determined values of these potentials are established by the h-f program. In considering the rapid changes of particle energy by emission of bremsstrahlung and frequency whistling, the h-f appears in the phase-oscillation equations which in this case so amplify the oscillating energy of a single particle that the particles exceed the given potential peak and are lost to the acceleration process. The problem is attacked using the Fokker-Planck equations directly for the energy distribution. (T.R.H.)

3519 (DESY-A2.64) BELASTUNGSPROBE DES MAGNETRINGTRÄGERFUNDAMENTES IN SEKTOR 2 AM 15./16. 6.1960. (Load Tests of the Magnet Ring Support Foundation in Sector 2 on 6/15 and 16, 1960). K. Marzahn. Deutsches Elektronen-Synchrotron, Hamburg. June 24, 1960. 4p.

Magnet ring support load tests for the Hamburg Electron Synchrotron are described and discussed. (T.R.H.)

3520 (DESY-A2.66) VORBEREITENDE UNTERSUCHUNGEN ZUR LANGSAMEN STRAHLAUSLENKUNG. TEIL II. (Preliminary Studies on Slow Radiation Deflection. Part II). F. Brasse. Deutsches Elektronen-Synchrotron, Hamburg. July 4, 1960. 30p.

By insertion of linear lenses, the working point of the accelerator can be placed at or near a betatron resonance. The amplitude of the betatron oscillations then increases to large values. So far as the increase occurs at a definite place in the machine and so far as its interval (Δr) per cycle is large enough, the particles can arrive at a deflection magnet (a magnet with a thin bus bar) which is located at the edge of the vacuum chamber and deflects the particles out. A mathematical treatment is presented with consideration being given to production of a betatron resonance with linear lenses and a resonance with nonlinear fields. (T.R.H.)

3521 (NP-tr-504) A 600 KV PROTON INJECTOR FOR A LINEAR ACCELERATOR. Yu. N. Antonov, L. P. Zinov'ev, and V. P. Rashevskii (Rashevskij). Translated by P. C. P. Mollet from report JINR-P-346, April 1959, Joint Inst. for Nuclear Research, Dubna, U.S.S.R. 20p.

Also published in Atomnaya Energ. 8, 454-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 17427.

3522 THE 680 Mev SYNCHROTRON. V. A. Petukhov. Atomnaya Energ. 9, 154-5(1960) Aug. (In Russian)

Descriptions are given of the specifications and performance of a synchrotron put in operation at the P. N. Lebedev Institute of Physics. The design of the accelerator is similar to that of the 10-Bev synchrophasotron with an injector (a Van de Graaff generator of 800 kv) and vacuum system. In the future the injector will be replaced by a pulse transformer, increasing the acceleration of electrons to 10^{10} ev. (R.V.J.)

3523 EFFECTS OF THE LEAKAGE FIELDS OF A SECTIONAL MAGNET ON THE DOUBLE FOCUSING OF A BEAM. Yu. A. Kholmovskiĭ. Atomnaya Energ. 9, 361-3 (1960) Oct. (In Russian)

The influence of the leakage field on the vertical focusing of charged particles is studied, and a method of calculation is suggested for double focusing sectional magnets considering the leakage field. (R.V.J.)

3524 BEAM LOSS AT THE LIMITING RADIUS IN A PHASOTRON. V. P. Dmitrievskiĭ, B. I. Zamolodchikov, and V. V. Kol'ga. Atomnaya Energ. 9, 303-5(1960) Oct. (In Russian)

Resonance interactions of radial and vertical oscillations near n = 0.25 were studied, and it is shown that such resonance is much more deleterious than the parametric excitation of vertical oscillations induced by the first harmonics in magnetic field structure. In high-energy synchrocyclotrons (400 to 700 Mev) the maximum particle acceleration energy corresponds to the radius where the drop of the magnetic field is at $0.25 > n > 0.2$ [$n = -(r\,dH/H\,dr)$]. Coupled oscillations at n = 0.2 do not induce complete loss of the beam. At frequencies $O_2 = 0.5$ (n = 0.25) the parametric excitation region of vertical oscillations is adjacent to the above area. The examined parametric excitation cannot appreciably increase the amplitude because the width of the resonance region at $E_1 \cong 0.001$ is less than 100 revolutions. An analysis is made of the effects which induce an increase in vertical oscillation amplitudes in the presence of azimuthal magnetic field heterogeneity, and of the coupled oscillations which originate with closed orbit distortion by the azimuthal heterogeneity in the field. Equations were developed for the vertical oscillations and the results were verified with an electron modeling device which resolved the problem of dynamic particle passage through a resonance with induced radial oscillations at n = 0.25. The equations were developed for two phasotron parameters (in Dubna and in Tokyo): E_{oscil} = 680 Mev; v = 10 kv; d = –10; and E_{oscil} = 57 Mev; v = 7 kv; d = –7.5. The relation $\ln(a_{max}/a_0) = f(E_1)$, after passing through the resonance at n = 0.25, is shown. The maximum amplitudes as a function of the first harmonics are plotted for 680 and 57 Mev phasotrons. (R.V.J.)

3525 COMPARISON OF CASCADE CIRCUITS FOR PRODUCING LARGE CURRENTS WITH LITTLE RIPPLE. A. A. Vorob'ev and S. F. Pokrovskiĭ. Atomnaya Energ. 9, 305-8(1960) Oct. (In Russian)

Experimental data and formulas are presented for various cascade circuit schemes. The pulsations of yield intensity δU are plotted as a function of the number of stages n for cascade generators with selenium rectifiers at a current load i = 1μa. The number of stages varied from two to seven at a frequency of 50 Hz. The capacity of each cascade was 1μf. The properties of various cascade circuits are analyzed and tabulated. (R.V.J.)

3526 INTERACTION OF TWO CONSECUTIVE BEAMS INJECTED IN A CIRCULAR ACCELERATOR. Alain Nakach. Compt. rend. 251, 1777-8(1960) Oct. 24. (In French)

A mechanism for particle loss by the effect of space charge observed particularly in Saturne is explained. In the synchrotrons with spiraled injection, two injected beams are together and are interacting. It is shown that one of the beams is driven back on the injector. (tr-auth)

3527 ON THE DYNAMICS OF PARTICLES IN A WAVEGUIDE CYCLIC ACCELERATOR. E. S. Kovalenko (Tomsk Polytechnic Inst., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 175-9(1960). (In Russian)

An ordinary stability problem is examined for an accelerator in which the high-frequency field has all the $\overline{E}$ and $\overline{H}$ vector components. The high-frequency components are assumed to have an arbitrary dependence on the coordinates r and z; while, in relation to the coordinate θ, the field is expressed as a propagating wave with the phase $\psi = \omega t - k\theta$. The precise equation proved too cumbersome; so an equation was developed with the assumption that field component expressions for the square wave frequencies and attenuation expressions of the cube order may be eliminated. The phase oscillations of particles moving in sharply heterogeneous, high-frequency fields are analyzed. (R.V.J.)

3528 ACCELERATORS IN RADIOGRAPHY. Nuclear Eng. 5, 517-22(1960) Nov.

A growing need has developed for radiographic methods that will undertake the work that is outside the scope of conventional x-ray plants. Two methods are described that provide what may be termed "supervoltage" x rays for the radiography of thick welds. The methods employ the Van de Graaff machine, the linear accelerator, and the betatron. Descriptions of several machines are given including their ratings and limitations for radiography. (B.O.G.)

3529 A 500-KV ION ACCELERATOR. M. Cevolani, S. Petralia, B. Righini, U. Valdrè, and G. Venturini (Università, Bologna). Nuovo cimento (10) 16, Suppl. No. 2, 168-83(1960). (In Italian)

A Cockcroft and Walton ion accelerator of 500 kv for the production of neutrons through the reactions $D(d,n)^3He$, $T(d,n)^4He$, and of γ rays from the reaction $Li^7(p,\gamma)Be^8$ is described. Characteristics of the ionic source employed are given. It is of the radiofrequency type with magnetic field and produces ion beams of more than 3 ma intensity. The maximum current observed on the accelerator's reaction target was 1.4 ma. Results of measurements made on the x radiation emitted by the operating accelerator and on the neutrons produced by the action of deuterons on tritium in zirconium are given. (auth)

3530 ON THE SIMULATION OF A SYNCHRO-CYCLOTRON PARTICLE BEAM BY MEANS OF A LIGHT MODULATOR. C. Cernigoi, I. Gabrielli, and G. Iernetti (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo cimento (10) 16, Suppl. No. 2, 256-8(1960). (In English)

In order to investigate the behavior of conventional plastic scintillator telescopes exposed to a particle beam, their operating conditions can be simulated using light modulated in intensity. By means of ultrasonic standing waves a repetition of short light pulses is obtained, so as to simulate the light emitted by the scintillators during the duty cycle of a machine. At a pulse repetition-rate of 16 MHz the light pulses present a width at half-amplitude of 11 ns. By splitting the modulated light beam to hit two or more photomultipliers, it is possible to test the whole electronic equipment related to a telescope. (auth)

3531 METHODS FOR DEVELOPING MAXIMUM BETATRON INTENSITY. B. B. Gel'perin, V. D. Gusakov, Kh. L. Luban, and N. N. Trofimova (Moscow Transformer Plant). Pribory i Tekh. Ekspt. No. 4, 13-17(1960) July-Aug. (In Russian)

Corrections are suggested for magnetic-field characteristics in betatrons. Descriptions are given of schemes for developing the maximum intensity. The effects of the described devices on intensity are described. (tr-auth)

3532 MEASUREMENTS OF THE DISTRIBUTION AND CURRENT OF PULSED CHARGED PARTICLE BEAMS. I. A. Grishaev, N. I. Mochashnikov, and V. F. Ivanov (Inst. of Physics and Tech., Academy of Sciences,

Ukrainian SSR). Pribory i Tekh. Ekspt. No. 4, 17-23 (1960) July-Aug. (In Russian)

Descriptions are given of a device for measuring the distribution and current of the beam passing from a linear electron accelerator. The order of accuracy for determining beam distribution is about 0.1 mm for beam currents $I > 1$ ma and pulse lengths $\gtrsim 0.5$ μsec. The sensitivity limit of the current measuring device is 20 mv/ma and can be applied for measuring pulsed currents from 5 to 10 μa. The suggested method of measuring beam distribution and current can be applied for any pulsed charged particle beam. (tr-auth)

3533 PREPARATION OF SOLID DEUTERIUM AND TRITIUM TARGETS FOR ELECTROSTATIC GENERATOR. E. A. Koltypin. Pribory i Tekh. Ekspt. No. 4, 130-1(1960) July-Aug. (In Russian)

The suggested design consists of a 0.3 mm target backed by a 14 mm molybdenum layer. The molybdenum backing acts as a vacuum seal and is water cooled. A rotating magnet disperses the focused ion beam over the target. Tritium targets coated with 0.5 mg/cm^2-thick titanium were bombarded with 1 to 2.5 Mev proton beams of 30 to 50 μa. The target power reached 100 v. Tritium losses did not exceed 20% after (2 to 3) $\times 10^3$ μa-hours. (R.V.J.)

Plasma Physics and Thermonuclear Processes

3534 (AD-235496) THE LINEARIZED SOLUTION FOR THE FLOW OF A CONDUCTING GAS THROUGH A CYLINDRICAL CHANNEL UNDER THE INFLUENCE OF A MAGNETIC FIELD. Mathematical Note No. 212. F. Edward Ehlers. Boeing Scientific Research Labs., Seattle. Mar. 1960. 87p. (DI-82-0009).

Magnetohydrodynamic equations for the axial-symmetric flow of a conducting gas through a cylindrical channel were linearized under the assumption of small magnetic Reynolds number and small magnetic-interaction parameter. It was assumed that the flow in the channel is uniform at infinity upstream and the magnetic field vanishes at infinity both downstream and upstream of the magnetic field sources. For axial-symmetric fields, the flow along the axis is isentropic. To a first approximation in the interaction parameter, the entropy of the gas is obtained from a simple integration of the square of the radial component of the magnetic field. For a single current loop and subsonic flow, the axial and wall perturbation velocity distributions were calculated. Most of the influence of the magnetic field was found to be in the vicinity of the current loop. Along the wall the velocity was first slightly accelerated then decelerated very rapidly in the neighborhood of the current loop. Far downstream on the wall the velocity asymptotically approached a value less than the upstream initial velocity. The axial velocity decreased slightly, then in the neighborhood of the coil increased rapidly to a downstream value which was greater than the initial undisturbed velocity. For the streamlines in the neighborhood of the axis, the gas was accelerated in passing through the field; while for streamlines near the wall, the gas was decelerated. Thus the effect of the magnetic field, is to deflect the stream from the wall toward the axis. Since the radial velocity vanishes far downstream of the current loop, a shear flow results in which the velocity decreases and the entropy increases as movement is directed from the axis to the wall of the channel. The resulting velocity, density, and entropy profiles are somewhat parabolic in shape. Since the linearized supersonic flow is more difficult to compute from the solution than the linearized subsonic flow, only the singularities of the kernel functions for the convolution integrals of the axial and wall perturbation velocities were investigated. Although the kernel functions become infinite along certain Mach lines, the resulting perturbation velocities are finite. The signs of the kernel function indicate an oscillatory variation along the tube for the axial and wall velocity distributions in supersonic flow. (auth)

3535 (AD-236361) MAGNETO-FLUID-DYNAMICS, BIBLIOGRAPHY 1. North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development. Feb. 1960. 38p.

This bibliography contains 692 references to report and journal literature pertaining to aspects of magnetohydrodynamics. (C.J.G.)

3536 (AERE-R-3328) PERTURBATIONS OF THE FAST AXIAL FIELD IN A SPLIT METAL TORUS. C. F. Vance. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Sept. 1960. 20p. BIS.

Some proposed experiments on pinched gas discharges with thin current skins call for rapid changes in axial field outside the pinch. An approximate method is given for finding the field inside the metal shell, for any distribution of coils or "feeders" connected to flanges on a mid-plane split in the shell. This is applied to a typical example with 16 equally spaced coils, for which it is shown that the relative perturbation of axial field at the discharge surface opposite the split is $\Delta H_z/H_0 = (a/h)\ F$, where (ΔH_z) is the amplitude of the perturbation, (H_0) is the mean change in (H_z), (a) is the spacing, (h) is the height of the flanges, and (F) is a coefficient of order unity. (auth)

3537 (AFCRC-TR-60-224) MAGNETO-HYDRODYNAMICS. Final Report. New York Univ., New York. Inst. of Mathematical Sciences. Dec. 1959. 16p. Contract AF19(604)-2138. (AD-236066).

A theory of two-dimensional steady hydromagnetic flow, developed by employing suitable generalizations of methods used in the steady flow theory of gas dynamics, is reviewed. Research developments in statistical hydromagnetics, reflection and refraction of weak discontinuities, motion of charged sheets in an electromagnetic field, and behavior of plane waves in a plasma are reported. Studies conducted on irreversible statistical mechanics of incompressible hydromagnetic turbulence and the structure of isotropic turbulence at very high Reynolds numbers are discussed. (C.J.G.)

3538 (AFSWC-TR-59-66) EXPANSION OF A PLASMA IN A UNIFORM FIELD. M. Bernstein and L. N. Zadoff. Republic Aviation Corp. Missile Systems Div., Mineola, N. Y. Nov. 9, 1959. 27p. Project No. 7811. Contract AF29(601)-1218. (MSD-206-957).

E. N. Parker's treatment of the expansion of a homogeneous plasma in a uniform field results in the case of spherically symmetrical initial conditions in a set of two differential equations in three unknown functions. By use of the principle of conservation of energy, one may eliminate one unknown immediately. The resulting set of two simultaneous nonlinear differential equations may then be solved in principle. A solution will permit calculation of the geometrical configuration, density, magnetic field intensity, internal energy, and pressure as functions of time, initial energy, and original magnetic field. For the stationary state, the derivatives disappear and an explicit

analytic solution is obtained. This solution is independent of Parker's assumptions concerning homogeneity during the expansion. (auth)

3539 (CML-SR-M-148-1) RESEARCH ON HIGH-TEMPERATURE PLASMA JETS. Quarterly Progress Report [for] June 15–September 15, 1958. P. J. Dickerman. Chicago. Univ. Chicago Midway Labs. 25p. Contract AF33(616)-5868.

The design of a magnet capable of providing a field strength of 25,000 gauss is reported. The magnet is to be used in studying the effects of an axial magnetic field on the flow properties and heat-transfer parameters of an ionized gas. Introduction of an easily ionizable substance into the gas (seeding) as an aid in studying magnetohydrodynamic effects is considered. Magnetohydrodynamic equations governing the ionized-gas flow are presented in computer-program form. (See also CML-SR-M-148-2.) (C.J.G.)

3540 (CML-SR-M148-2) RESEARCH ON HIGH-TEMPERATURE PLASMA JETS. Quarterly Progress Report [for] September 15–December 15, 1958. P. J. Dickerman. Chicago. Univ. Chicago Midway Labs. 41p. Contract AF33(616)-5868.

A horizontal plasma generator was fabricated, based on the design of a 1.1-Mw air-stabilized arc. Equations concerning the flow properties and heat-transfer parameters of an ionized gas flowing in an axial magnetic field are presented. A program for numerical computation of the equations on a digital computer is presented. (For preceding period see CML-SR-M-148-1.) (C.J.G.)

3541 (JPL-TR-32-14) ON THE DISTRIBUTION FUNCTION AND MEAN ENERGY OF ELECTRONS IN A SLIGHTLY IONIZED GAS IN THE PRESENCE OF MAGNETIC AND ELECTRIC FIELDS. Ching-Sheng Wu. California Inst. of Tech., Pasadena. Jet Propulsion Lab. July 1, 1960. 25p. Contract NASw-6.

The distribution function and mean energy of electrons in a slightly ionized gas in the presence of magnetic and electric fields not necessarily perpendicular were calculated. Based upon the work of Chapman and Cowling and on the assumption that electron-ion and electron-electron collisions are not important, the electron distribution function is obtained to the second approximation. (C.J.G.)

3542 (JPL-TR-32-23) A GENERALIZED OHM'S LAW OF PLASMA. Ching-Sheng Wu. California Inst. of Tech., Pasadena. Jet Propulsion Lab. May 10, 1960. 25p. Contract NASw-6.

A generalized Ohm's law is derived for an ionized gas in the presence of electrical and magnetic fields with arbitrary orientations. Two different methods are used in the analysis, but the results are in complete agreement. It is found that in general when the magnetic field and the electrical field are neither parallel nor perpendicular, an additional current normal to both the direct current and the Hall current is theoretically observed. (auth)

3543 (MATT-49) ON THE CONTINUUM RADIATION IN IONIZED GASES. Nandor Balazs. Princeton Univ., N. J. Project Matterhorn. July 1960. 28p. Contract AT(30-1)-1238. OTS.

A survey of theories that describe the continuous radiation spectrum issuing from hot ionized gases is presented. The present technology indicates that for dilute gases the qualitative features of the emission are understood. For quantitative results the correct quantum mechanical cross sections for bremsstrahlung and recombination, including the case of large energy losses are required. For denser gases even a good qualitative understanding is lacking. For quantitative work three-body-encounter cross sections and a method to find three-body distribution functions are needed. (auth)

3544 (NP-9266) DYNAMIC STABILIZATION OF A PLASMA COLUMN. Erich S. Weibel. Space Technology Labs., Inc. Physical Research Lab., Los Angeles. Aug. 15, 1960. 62p. (STL/TR-60-0000-GR269).

The dynamic stabilization of a cylindrical plasma column which is confined by a magnetic field whose z-component is constant while the φ-component oscillates sinusoidally is considered. The skin depth is assumed to be negligible so that the boundary can be considered as sharp and the interior of the plasma as field free. The plasma is treated as an assembly of noncolliding particles which are specularly reflected at the plasma surface. The oscillating pressure of the applied field is shown to induce a small periodic motion independent of φ and z in the plasma surface. All other components of the displacement decay in time, therefore the plasma is positively stable against all deformations. For magnetostatic confinement this treatment yields the usual instabilities, but the growth rates are bounded as the deformation wave length approaches zero. (auth)

3545 (NP-9267) A PROPOSED RADIAL PLASMA GUN. Rijnhuizen Report 60-02. L. Th. M. Ornstein. Stichting voor Fundamenteel Onderzoek der Materie. Instituut voor Plasma-Fysica, Jutphaas, Netherlands. July 1960. 22p.

The velocity of a magnetically driven cylindrical plasma sheath which is accelerated radially inward and injected into a quadrupole magnetic bottle is calculated. The behavior of the plasma shell after piercing the magnetic field and entering the bottle is discussed. (C.J.G.)

3546 (NYO-9355) THERMONUCLEAR PLASMA CONTAINMENT IN OPEN-ENDED SYSTEMS. Harold Grad. New York Univ., New York. Inst. of Mathematical Sciences. Sept. 30, 1960. 25p. Contract AT(30-1)-1480. (MF-7). OTS.

A survey is presented of the theory of plasma confinement in open-ended systems (such as mirror machines and cusped geometries) together with the slight amount of experimental confrontation with theory that exists at present. (auth)

3547 (JPRS-5871) ACCELERATION OF DISCHARGE PLASMA AND THE PRODUCTION OF STRONG SHOCK WAVES IN A CHAMBER WITH COAXIAL ELECTRODES. (Uskoreniye Plazmy Razryada i Polucheniya Sil'nykh Udarnykh Voln v Kamere Koaksial'nymi Elektrodami). S. R. Kholev and D. S. Poltavchenko. Translated from Doklady Akad. Nauk S.S.S.R. 131, 1060-3(1960). 10p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 18532.

3548 A NEW ELECTRIC DISCHARGE FORM WHICH WAS OBTAINED BY SUPERPOSING TWO DISTINCT TYPES OF DISCHARGE. G. D. Cristescu (Institutul de Fizică, Academia R.P.R.). Ann. Physik (7) 6, 153-5(1960). (In German)

By superposition of a direct current or an intermittent current on a high-frequency torch discharge a new discharge form was obtained which had properties not dependent only on the parameters of the torch alone, but also on the superposed current. Used as a spectral source, this

type of discharge offers various excitation possibilities. (tr-auth)

3549 SOME CRITERIA FOR THE DIRECT TRANSFORMATION OF NUCLEAR ENERGY INTO ELECTRICITY. J. C. Linhart. Atom u. Strom 6, 83-5(1960) Sept. (In German)

The characteristics of a thermonuclear reaction that could be used for direct transformation into electrical energy are briefly described. (J.S.R.)

3550 EFFECT OF A PREIONIZATION ON THE EFFICIENCY OF A MAGNETIC COMPRESSION. EXPERIMENTAL RESULTS OBTAINED. Terenzio Consoli, Richard Geller, and René Legardeur. Compt. rend. 251, 1753-5(1960) Oct. 24. (In French)

The apparatus described permits, before a rapid compression, the preionization of the neutral gas and the preheating, by cyclotron resonance of the ions, of the plasma thus formed. The first results show the effect of this preliminary operation. (tr-auth)

3551 INTERACTIONS OF ELECTRON IN MOTION IN MAGNETIC FIELD, WITH VACUUM. V. S. Tumanov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 112-16(1960). (In Russian)

Interactions of electrons in a uniform magnetic field are studied. Closed integral expressions derived for the matrix elements of interactions hold true for any field intensity. The first terms of the expansion are calculated by the degrees of H/H_0($H_0 \sim 10^{13}$ Gauss). (R.V.J.)

3552 CHARACTERISTICS OF XENON AND ARGON PLASMA BEHIND A SHOCK WAVE. S. R. Kholev (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 4, 30-9(1960). (In Russian)

Studies were made of luminescence behind a strong (up to M = 35) shock wave in xenon. The temperature (24,000°K) measured behind the shock wave was correlated with the temperature measured along the incident wave and with the temperature of a reflection. (tr-auth)

3553 FORCES ON CHARGED PARTICLES OF A PLASMA IN A CAVITY RESONATOR. J. W. Gallop, T. L. Dutt, and H. Gibson (English Electric Co., Ltd., Stafford, Eng.). Nature 188, 397-8(1960) Oct. 29.

An analysis was begun of the conditions required for the containment of an ionized plasma by high-frequency electromagnetic waves, considering the collisions and space-charge forces in the plasma. Two types of confining forces are present when the plasma interacts with the wave in the presence of large field gradients. One is caused by the electric field acting on the electrons, as analyzed by Boot et al. The unidirectional force is called the electromagnetic force. It results from the interaction of the electron current set up by the electron moving in the electric field with the magnetic field component of the electromagnetic wave. For the electric force or Mathieu force to become unidirectional, certain relations between amplitude, gradient, and frequency of the electric field and electron density must be fulfilled. The nature of the solution of the Mathieu equation may be deduced from an examination of the stability chart. (B.O.G.)

3554 MECHANISM OF THE LINEAR PINCH EFFECT. Hartmut Zwicker and Fritz Dieter Erbslöh (Technische Hochschule, Hanover). Naturwissenschaften 47, 440(1960). (In German)

In the investigation of pulse discharge in low-pressure gases, cinematographic and electrical measurements were combined on a condenser discharge of 25 kwsec at 31 kv. The cylindrical discharge vessel was enclosed in a copper cylinder for current regeneration. Helium between 0.1 and 10 Torr was used as the discharge gas. Two new phenomena were observed. At pressures of approximately 1 Torr shortly after the contraction phase at the walls of the discharge vessel a fairly sharply defined glowing stripe occurs, which after several seconds becomes extinct in the instability of the discharge. The phase of maximum contraction is made noticeable in the current path only by a valley when it lies in front of the first zero passage of the current. The significance of these phenomena are discussed. (J.S.R.)

3555 SPIN SUSCEPTIBILITY OF AN ELECTRON GAS. P. A. Wolff (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. 120, 814-19(1960) Nov. 1.

The generalized random phase approximation is used to investigate the effects of electron-electron interaction on the spin susceptibility of an electron gas. Within this approximation, the induced spin density is determined by the solution of an integral equation that describes exchange scattering between virtually excited particles. Solutions to this equation are obtained in simple cases. They indicate that the exchange scattering enhances the susceptibility over that predicted by the Ruderman-Kittel formula by factors which, for electron densities comparable to those found in good metals, are in the range 1 to 2. These results can be derived by summing certain classes of diagrams in many-body perturbation theory. The structure of these graphs shows that the random phase approximation considers the simplest sort of self-energy effect and the simplest type of scattering of virtually excited particles. (auth)

3556 MEASUREMENTS OF TEMPERATURES AND DENSITIES IN SHOCK-HEATED HYDROGEN AND HELIUM PLASMAS. Wolfgang Wiese, H. F. Berg, and H. R. Griem (Univ. of Maryland, College Park). Phys. Rev. 120, 1079-85(1960) Nov. 15.

Temperatures and densities in plasmas produced by strong magnetically driven shock waves in a "T tube" were measured spectroscopically. Local thermal equilibrium exists within experimental accuracy for the conditions of this experiment. In both gases, the measured temperatures and densities are in disagreement with the values expected from the Rankine-Hugoniot relations unless it is assumed that the conditions in the ambient gas are drastically affected by the initial discharge. Consistency between experiment and shock theory is achieved by considering magnetic pressure and dissociation and excitation of the ambient gas by uv radiation from the discharge. (auth)

3557 THE MANY-VALUED CHARACTER OF THE SCALAR MAGNETIC POTENTIAL IN THE HYDROMAGNETIC STABILITY PROBLEMS OF A PLASMA. R. Lüst and E. Martensen (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch. 15a, 706-13(1960) Aug. (In German)

Bernstein, Frieman, Kruskal, and Kulsrud have found a variational principle (energy principle) which provides a necessary and sufficient condition for the stability of a plasma configuration surrounded by a vacuum and an external conductor. In this energy principle the perturbed magnetic field in the vacuum is derived from a vector potential. In the present investigation the energy principle is

formulated with the help of a magnetic scalar potential instead of the vector potential, which simplifies the application of the principle. The many-valued character of the scalar potential assures that this description is equivalent to that using the vector potential. The nature of this many-valuedness is thoroughly investigated. (auth)

3558 THE ELECTRICAL CONDUCTIVITY OF A PLASMA AT HIGH TEMPERATURES. H. Wilhelm (Technische Hochschule, Stuttgart). Z. Naturforsch. 15a, 749-51(1960) Aug. (In German)

It was shown that in the calculation of the electrical conductivity of a plasma at extremely high temperatures, wave mechanical effects must be considered. The critical temperature, above which deviations of the electrical conductivity from the values calculated by classical gas dynamics appear, is proportional to the square of the effective charge number of the plasma. (tr-auth)

3559 MAGNETO-ACOUSTIC RESONANCE IN A PLASMA. A. P. Akhmatov, P. I. Blinov, V. F. Bolotin, A. V. Borodin, P. P. Gavrin, E. K. Zavoĭskiĭ, I. A. Kovan, M. N. Oganov, B. I. Patrushev, E. V. Piskarev, V. D. Rusanov, G. E. Smolkin, A. R. Striganov, D. A. Frank-Kamenetskiĭ, P. A. Cheremnykh, and R. V. Chikin. Zhur. Eksptl'. i Teoret. Fiz. 39, 536-44(1960) Sept. (In Russian)

An experimental study was made of vibrations of a magnetoacoustic type in a cold plasma. It is shown that under certain conditions, an h-f electromagnetic field strongly penetrates into the plasma with an attendant resonance absorption of energy of the field. The results of investigation of resonance at frequencies of 12.5 and 50 mc/s by various methods are described. The results are compared with the theoretical predictions. (auth)

3560 ON THE FLOW OF A PLASMA INTO VACUUM IN THE PRESENCE OF A MAGNETIC FIELD. R. V. Polovin (Inst. of Physics and Mathematics, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 657-61(1960) Sept. (In Russian)

Hydromagnetic waves excited by disintegration of the boundary between the plasma and vacuum were investigated. The boundary velocity (escape velocity) was determined. The amplitude of the electromagnetic wave emitted in vacuum during disintegration of the discontinuity was also determined. (auth)

3561 PROPER OSCILLATIONS OF A RESTRICTED PLASMA. D. A. Frank-Kamenetskiĭ. Zhur. Eksptl'. i Teoret. Fiz. 39, 669-79(1960) Sept. (In Russian)

The general properties of cylindrical waves in a cold plasma were considered. The results obtained were applied to the low-frequency proper oscillations of a plasma cylinder surrounded by conducting walls. The conditions of magnetoacoustic resonances which ensure an effective penetration of the oscillations into the plasma were derived. The nature of the resonance phenomena depends on the linear density of the electrons. Approximate formulas are presented for the proper frequencies of a long plasma cylinder. It is shown that in the vicinity of the mean geometrical value of the electron and ion cyclotron frequencies, purely radial oscillations are not feasible since even small angular deviations sharply change the resonance frequency. (auth)

3562 QUANTUM OSCILLATIONS OF THE THERMAL CONDUCTIVITY COEFFICIENT OF AN ELECTRON GAS IN A MAGNETIC FIELD. V. V. Andreev and A. M. Kosevich (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 741-5(1960) Sept.

The quantum oscillations of the thermal conductivity coefficient of the conductivity electrons in a strong magnetic field H ($\omega\tau \gg 1$, $\omega = eH/mc$, τ is the relaxation period) were computed at low temperatures ($kT \ll \zeta$, ζ is the chemical potential of the electron gas), where scattering of the electrons on impurities was of decisive importance. It is shown that the oscillating part of the thermal conductivity coefficient can be expressed in a simple manner through the oscillations of the specific electric conductivity. (auth)

3563 INVESTIGATION OF THE STABILITY OF A PLASMA BY A GENERALIZED ENERGY PRINCIPLE. V. F. Aleksin and V. I. Yashin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 822-6(1960) Sept.

Stability conditions were derived for a plasma possessing an anisotropic particle velocity distribution and located in a cylindrically symmetric magnetic field. Cases of longitudinal and azimuthal magnetic fields were considered. (auth)

3564 ELECTROMAGNETIC WAVES IN HALF-SPACE FILLED WITH A PLASMA. Yu. N. Dnestrovskiĭ and D. P. Kostomarov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 845-53(1960) Sept.

The propagation of electromagnetic waves across a magnetic field in half-space filled with a magnetoactive plasma was studied. It was assumed that the plasma was confined by a stationary magnetic field H. The structure of this field was investigated for the case when the ratio of the plasma pressure to the magnetic pressure was small. It was demonstrated that at large distances from the plasma boundary, an electromagnetic wave with an electric vector parallel to the magnetic field H has the form of a plane wave with a propagation constant that is specified by the equation for an infinite plasma. The reflection and transmission coefficients were evaluated for a plane wave striking the plasma from vacuum. (auth)

3565 COLLISIONS OF PARTICLES IN A HIGH TEMPERATURE PLASMA. O. V. Konstantinov and V. I. Perel (Inst. of Physics and Tech., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 861-71(1960) Sept.

A kinetic equation was derived for a high temperature plasma. The effective cross sections for collisions between electrons and electron-ion collisions were computed without artificially cutting off the interaction. The role of plasma oscillations in the plasma kinetics was elucidated. It is shown that the effect of the ions on screening of the interaction should be taken into account during electron-ion collisions. (auth)

3566 EFFECT OF PULSED ACOUSTIC RESONANCE ACTION OF A NUCLEAR SPIN SYSTEM. A. R. Kessel (Inst. of Physics and Tech., Kazan Branch, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 872-7 (1960) Sept.

The effect of acoustic pulses of a resonance frequency ω and duration $t_\omega < T_2$ on a system of nuclear spins $I > \frac{1}{2}$ was examined theoretically. It is shown that in contrast to the action of an electromagnetic field on the spin system, a single acoustic pulse does not induce a free precession signal in the first approximation in $\hbar\omega/kT$. Two acoustic pulses produce a spin echo signal which equals that produced by electromagnetic pulses. (auth)

3567 QUANTUM OSCILLATIONS OF THERMODYNAMIC QUANTITIES FOR AN ARBITRARY FERMI SURFACE. M. Ya. Azbel (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 878-87(1960) Sept.

Thermodynamic quantities of an electron gas in a constant magnetic field H were calculated in the general case of a non-convex Fermi surface. It is shown that the presence of trajectories with self-intersection leads to quantum oscillations of these quantities as a function of H. It is pointed out that the experimentally observed oscillations corresponding to anomalously weakly filled bands may be due either to separated small surfaces which are then described by the Lifshitz–Kosevich theory, or by small convexities or depressions in the main large band, in which case they are described by the present theory. (auth)

3568 METHOD AND APPARATUS FOR RAISING A GAS TO A HIGH TEMPERATURE. Lyman Spitzer, Jr. British Patent 850,821. Oct. 5, 1960.

Two embodiments of a Stellarator design are presented for raising a gas, particularly hydrogen isotopes, to high temperatures on the order of 10^{8}°K. The gas is confined in the Stellarator by a magnetic field running along its axis and an electric current flowing around it. Some theory and operational characteristic curves are given. (D.L.C.)

3569 IMPROVEMENTS IN OR RELATING TO THERMONUCLEAR REACTORS. Roger Hancox (to United Kingdom Atomic Energy Authority). British Patent 851,148. Oct. 12, 1960.

A thermonuclear reactor of the pinched discharge type can be designed so that the temperature gradient in the heat-absorbing surface is kept low by constructing it from beryllium, which is more transparent to x rays and bremsstrahlung than other materials. For example, at a plasma temperature of 5×10^{8}°K, beryllium walls of thickness 1, 2, 5, and 10 mm absorb only 16, 22, 33, and 45% of the incident radiation, respectively, and the gradient remains approximately the same for specific beryllium walls in the range 10^{8} to 10^{9}°K. In a preferred embodiment of the invention, coolant-carrying beryllium tubes are coiled around the pinch discharge. Another advantage of using beryllium is that if it should vaporize, the poisoning effect on the plasma would not be as serious as with materials of higher atomic number, since the increase in bremsstrahlung is not as great. (D.L.C.)

Shielding

3570 (CF-60-10-37) INSTRUCTIONS FOR THE OPERATION OF AN ORACLE CODE FOR A MONTE CARLO SOLUTION OF THE TRANSPORT PROBLEM FOR GAMMA RAYS INCIDENT UPON A SLAB. S. Auslender and D. K. Trubey. Oak Ridge National Lab., Tenn. Oct. 26, 1960. 39p. OTS.

A program has been coded for the ORACLE which will solve, using Monte Carlo techniques, the transport problem for monodirectional, monoenergetic γ radiation incident at an angle Θ upon an infinite laminated slab of finite thickness. The code is designed to give estimates of energy deposition, energy flux, tissue dose rate, reflected and transmitted energy current, and the angular and energy distribution of the reflected and transmitted energy current. (W.D.M.)

3571 (CEA-tr-A-724) ETUDES DE LA PROTECTION CONTRE LES RAYONNEMENTS DANS LE DOMAINE DES MATÉRIAUX DE CONSTRUCTION. (Study of Protection Against Radiation in the Field of Construction Materials). E. G. Niemann. Translated into French by P. Monnard. 7p.

[Presented at a] Conference on Atomic Piles for Naval Construction, held in Hamburg, November 25-28, 1959.

Several studies made on different types of concrete are discussed with respect to their use for protection against radiation. The effects of geometry, energy spectrum, and neutron activation are considered. (T.R.H.)

3572 (CEA-tr-I-34) SECTION EFFICACE D'ABSORPTION DU CARBONE ET DU GRAPHITE POLYCRISTALLIN. (Absorption Cross Section of Carbon and Polycrystalline Graphite). G. Gandusio and S. Polezzo. Translated into French by L. Roulet from Energia nucleare (Milan) 5, 383-6(1958). 15p.

A review is presented of the methods and results of measurement of the absorption cross sections of polycrystalline graphite in a thermal neutron flux. It is concluded that noticeable margins of error still exist in such measurements. The pile-oscillator method offers the best results, and a value of 3.2 mb for ideal carbon has the greatest probability of being exact. (T.R.H.)

3573 SHIELDING CALCULATIONS FOR NUCLEAR REACTORS. [PART] II. Karl-Heinz Lindackers (Technische Überwachungs-Vereins, Cologne). Atomkernenergie 5, 379-83(1960) Oct. (In German)

In this last section of the report on shielding calculations for reactors, the calculation of the effect of γ radiation on the dose output at the reference point is described. It is concluded that the total RBW dose output at a reference point is the sum of the RBW dose output calculated for the individual energy groups of the neutrons and γ radiation. (J.S.R.)

3574 ATTENUATION OF THE γ-RAYS FROM SOURCES EXTENDED IN THREE DIMENSIONS BY LEAD AND IRON. G. V. Gorshkov and V. M. Kodyukov. Atomnaya Energ. 9, 139(1960) Aug. (In Russian)

Experiments with metallic containers filled with aqueous solutions of colloidal gold (Au^{198}, $E_2 = 0.411$ Mev) and NaCl (Na^{24}, $E = 1.38$ Mev and $E_2 = 2.76$ Mev) showed that at given geometries the attenuation of γ rays from extended sources is similar to the attenuation for a point source when the build-up factor is ($V = K_{theor.}/K_{exp.}$). The build-up factor for the extended sources is less than for the point source and depends on the shape. The buildup factor increases with reduced γ energy and decreases with the increase of the absorber atomic number. The increase in a three-dimensional-extended source in a lead absorber is close to 1.0 at $\mu l < 3$. (R.V.J.)

3575 ATTENUATION OF THE γ-RAYS FROM POINT SOURCES BY VARIOUS MEDIUMS. V. M. Kodyukov. Atomnaya Energ. 9, 140(1960) Aug. (In Russian)

The attenuation of γ rays from 1-c point sources of Au^{198} ($E = 0.411$ Mev), Zn^{65} ($E = 1.12$ Mev), and Na^{24} ($E_1 = 1.38$ Mev and $E_2 = 2.76$ Mev) in water, lead, and iron was investigated. The tabulated data show that the build-up factor ($V = K_{theor.}/K_{exp.}$) is a function of boundary conditions; with an increase in absorber atomic number and γ energy the effects of the medium boundary are reduced. (R.V.J.)

3576 IMPROVEMENTS IN OR RELATING TO RADIATION-ABSORBING PROTECTIVE MATERIALS AND PROCESSES FOR THE PRODUCTION OF SAME. Karl Reinig. British Patent 851,602. Oct. 19, 1960.

A resilient radiation-absorbing protective material for x rays and ultra short wave radiation may be fabricated by using a fat or synthetic rubber incorporating a lead compound with an acid radical and an optical brightening agent. The lead compound may be lead nitrate or lead sulfate, and the brightening agent may be one used for textiles, e.g., Blankofor WL. The material may be used as a paint to coat walls (e.g., of packages or vehicles for trans-

porting radioactive materials) or to impregnate fibrous carriers (e.g., gloves). In the latter case, if the carrier is inflammable, it is advantageous to incorporate a flame-proofing agent like Akaustan A. The material may also be applied as a skin cream to the body parts to be protected from radiation. The procedure for preparing the material is given. (D.L.C.)

Theoretical Physics

3577 (NP-9252) DEMONSTRATION OF QUANTUM MECHANICS IN THE LARGE. Technical Report No. 195. T. B. Day. Maryland. Univ., College Park. Sept. 1960. 12p.

A striking effect of quantum mechanics in the large was recently pointed out by Lee and Yang. The effect bears on the objections raised by the Einstein-Rosen-Podolsky paradox and is a facet of the neutral K-meson system. Lee and Yang's remarks are discussed, and an experimental arrangement for demonstrating the effect using photons is pointed out. The experiment is similar to the measurement of the correlation of the directions of polarization of the two quanta from positronium annihilation but with magnetic channels added. (W.D.M.)

3578 INVESTIGATIONS OF THE NEW TAMM-DANCOFF METHODS. Hans Jürgen Kaiser (Technische Hochschule, Dresden). Ann. Physik (7) 6, 131-49(1960). (In German)

The infinite equation system between the amplitudes of the new Tamm-Dancoff methods was interrupted by setting suitable linear combinations (ϕ functions) of these amplitudes equal to zero. The directions remain limited to the Tamm-Dancoff amplitudes which contain the vacuum state. A generalization of the ψ functions allows the calculation of differences of neighboring eigenvalues so that empirical approximations and more simple equations are obtained. The method was investigated on quantum mechanical examples and applied to a nonlinear Bose field and to the Heisenberg elementary particle theory. An infinite discrete mass spectrum is obtained. (tr-auth)

3579 THE THEORY OF THE EFFECTIVE RANGE. T. Tietz (Univ., Lódź, Poland). Ann. Physik (7) 6, 150-2 (1960). (In German)

A formula is derived for the phase displacement for the Yukawa potential. The formula derived for the phase displacement permits, in a simple manner, the calculation of the cross section of neutron-proton scattering at low energies. (tr-auth)

3580 VARIATIONAL CALCULATIONS WITH REPULSIVE CORE POTENTIALS. N. Austern and P. Iano (Univ. of Pittsburgh). Nuclear Phys. 18, 672-80(1960) Sept. (2). (In English)

A variational method is described which is suitable for fairly detailed calculations with repulsive core potentials. The method employs a wave function which goes over to an exact solution of the two-body Schrödinger equation whenever two nucleons are closer together than a certain distance b. The ideas of effective range theory suggest that the results should not be sensitive to the energy parameter which characterizes the exact solution, a suggestion which is seen to be valid to great accuracy in a numerical calculation with a simple but characteristic potential. The new method is compared with straightforward variational approaches to the same problem, as well as with variational procedures based on a cutoff potential, and is found superior to them both. A practical application of the new method in calculating the Li^6 structure is cited. (auth)

3581 BOUNDS ON SCATTERING PHASE SHIFTS: STATIC CENTRAL POTENTIALS. Leonard Rosenberg and Larry Spruch (New York Univ., New York). Phys. Rev. 120, 474-82(1960) Oct. 15.

It was recently shown that rigorous upper bounds on scattering lengths can be obtained by adding to the Kohn variational expression certain integrals involving approximate wave functions for each of the negative-energy states. For potentials which vanish identically beyond a certain point, it is possible to extend the method to positive-energy scattering; one obtains upper bounds on $(-k\cot\eta)^{-1}$, where η is the phase shift. In addition to the negative-energy states one must consider a finite number of states with positive energies lying below the scattering energy. The states in this associated energy eigenvalue problem are defined by the imposition of certain boundary conditions on the wave functions. A second approach, involving an associated potential-strength eigenvalue problem, is used. The second method includes the first as a special case and, more significantly, can be extended to scattering by compound systems. If some states are not accounted for, a bound on $\cot\eta$ is not obtained; nevertheless it is still possible to obtain a rigorous lower bound on η. Upper bounds on η may also be obtained, but in a way which is probably not very useful for many-body scattering problems. (auth)

3582 INVARIANCE UNDER ANTIUNITARY OPERATORS. G. Feinberg (Columbia Univ., New York). Phys. Rev. 120, 640-2(1960) Oct. 15.

It is shown that for transitions between "weakly interacting" states, the transition matrix $\mathcal{T}$ can be expressed in terms of a Hermitian operator $\mathcal{T} + \mathcal{T}^\dagger$, and so invariance of the Hamiltonian under antiunitary operators such as T or TCP implies invariance of transition rates under kinematic transformations, without changing the direction of time. An application is made to π^0 decay into 2 photons, where it is shown that invariance under TCP alone implies equality in the number of left and right circularly polarized photons, to 1 part in 10^4. (auth)

3583 THE INTERPRETATION OF QUANTUM MECHANICS. Wolfgang Weidlich (Freie Universität, Berlin). Z. Naturforsch. 15a, 651-4(1960) Aug. (In German)

General conditions are given for the relationship of a possible parameter space, in which a given description of the physical system should occur, with the Hilbert space of quantum mechanics. The validity of quantum theoretical measurement axioms and motion equations is assumed. (tr-auth)

3584 TWO-POINT FUNCTION IN NON-LINEAR SPINOR THEORY. H. Mitter (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch. 15a, 753-8(1960) Sept. (In German)

The propagation function of a nonlinear spinor theory with γ_5 invariance is studied in an approximation that neglects four-point and higher correlations. The resulting nonlinear differential equation is solved. The only solution fulfilling certain general physical requirements (microcausality, positive energies) corresponds to a "dipole ghost" of zero rest mass. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

3585 (ANL-6205) PROCEEDINGS OF THE CONFERENCE ON TRANSFER FUNCTION MEASUREMENTS AND REACTOR STABILITY ANALYSIS HELD AT

ARGONNE NATIONAL LABORATORY, ARGONNE, ILLINOIS, MAY 2-3, 1960. Argonne National Lab., Ill. 332p. Contract W-31-109-eng-38. OTS.

The conference provided an exchange of current information between knowledgeable people working in the subject field. Analytic methods were discussed, and experimental measurements and analyses of operating thermal and fast reactors were reviewed. Twenty-three papers together with records of the discussion periods held following each paper are given. Four sessions were held on transfer function use in reactor dynamic studies, thermal reactor measurements and analysis of stability, fast reactor measurements and analysis of stability, and pile oscillator reactivity measurements. Separate abstracts were prepared for 22 of 23 papers. (W.D.M.)

3586 (ANL-6205(p.9-17)) REACTOR TRANSFER FUNCTIONS. J. P. Franz. Westinghouse Electric Corp. [Bettis Atomic Power Lab.], Pittsburgh.

To extend the transfer function method to the analysis of nonlinear systems, describing function methods were introduced. Transfer function techniques are briefly reviewed and the describing function is defined and illustrated. (W.D.M.)

3587 (ANL-6205(p.18-44)) TRANSFER FUNCTION REPRESENTATION OF NUCLEAR POWER PLANTS. Elias P. Gyftopoulos. Massachusetts Inst. of Tech., Cambridge.

The concept of transfer function representation of nuclear power plants has proved a very useful tool from the points of view of dynamic analysis and the interpretation of experimental data. Typical transfer functions of various components or processes of nuclear power plants and some conclusions that may be derived by means of simple manipulation are presented. (W.D.M.)

3588 (ANL-6205(p.45-73)) POWER-VOID TRANSFER FUNCTION MEASUREMENTS IN A SIMULATED SPERT IA MODERATOR COOLANT CHANNEL. S. Zivi and R. W. Wright. Ramo-Wooldridge. [Div. of Thompson Ramo-Wooldridge, Inc.], Canoga Park, Calif.

Power-void feedback in small oscillator theory, as a possible cause of boiling water reactor instability, was investigated by experimental measurements of power-void transfer functions. Purely hydrodynamic oscillations are another possible mechanism for the boiling instabilities. The measurements were made with a boiling loop which contained a simulated SPERT-1A moderator-coolant channel that was electrically heated and matched the heat capacity of a channel in the reactor. (W.D.M.)

3589 (ANL-6205(p.74-89)) COMBINED REACTOR AND POWER SYSTEM ANALYSIS FOR A BOILING WATER REACTOR. E. R. Owen. General Electric Co. [Atomic Power Equipment Dept.]., San Jose, Calif.

A few of the obvious considerations and objectives involved in a combined reactor and power system analysis are briefly reviewed. Some of the methods used to study or analyze the more basic areas peculiar to a boiling water reactor plant are reviewed. The analysis method or models of other non-nuclear components, such as heat exchangers, etc., are not considered. Methods of analysis of the reactor-steam void loop used in system studies of a boiling-water reactor system are discussed. (W.D.M.)

3590 (ANL-6205(p.90-6)) METHODS OF INVESTIGATING NOISY POWER REACTORS. PART I. J. A. Thie. Argonne National Lab., Ill.

The cross-correlation method for obtaining an accurate transfer function under poor signal-to-noise ratio conditions is described. The boiling reactor experiments are reviewed since they offer good examples of making measurements on potentially unstable systems under adverse conditions, i.e., in the presence of noise. (W.D.M.)

3591 (ANL-6205(p.97-107)) METHODS OF INVESTIGATING NOISY POWER REACTORS. PART II. Z. A. Akcasu. Argonne National Lab., Ill.

The improvement of the signal-to-noise ratio in reactor transfer function measurements by digital cross-correlation analysis is considered. The main problem in reactor transfer function measurements with periodic reactivity input is to determine the amplitude and the phase of an output signal in the presence of the reactor noise with a given accuracy. Cross-correlation technique proves to be an effective method to improve the signal-to-noise ratio, and thus the precision, in such measurements. (W.D.M.)

3592 (ANL-6205(p.111-14)) MEASUREMENT AND ANALYSIS OF THE KEWB TRANSFER FUNCTION BY REACTOR MODULATION TECHNIQUES. PART I. E. R. Cohen. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A brief description is given for reactor modulation techniques in the measurement and analysis of reflected reactor transfer functions. It is pointed out that experimental transfer functions for reflected reactors should be interpretable in terms of additional delayed neutron groups. (W.D.M.)

3593 (ANL-6205(p.115-33)) MEASUREMENT AND ANALYSIS OF THE KEWB TRANSFER FUNCTION BY REACTOR MODULATION TECHNIQUES. PART II. R. N. Cordy. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

Analysis of transient experiments has indicated that the performance of the KEWB Reactor is not adequately described by the conventional reactor kinetic model using six groups of delayed neutrons. A reactor modulation experiment was performed in order to resolve this anomaly and to obtain an independent determination of the ratio of prompt neutron lifetime to the effective fraction of delayed neutrons. (W.D.M.)

3594 (ANL-6205(p.134-55)) EBWR STABILITY ANALYSES. Walter C. Lipinski. Argonne National Lab., Ill.

One of the first major efforts of the EBWR experimental program was a stability investigation. The objective of this investigation was to evaluate maximum stable power output capabilities of the reactor by the use of a small-signal linear feedback control theory. (W.D.M.)

3595 (ANL-6205(p.156-73)) HIGH AND LOW POWER SPERT-I TRANSFER FUNCTION MEASUREMENTS. A. A. Wasserman. Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

Progress is indicated in transfer function measurements which are part of the SPERT program in reactor kinetics. An initial set of measurements made under various conditions in SPERT-1 is outlined, the apparatus used is described in detail, some problems involved in the tests are discussed, and the status of the data analysis is summarized. (W.D.M.)

3596 (ANL-6205(p.174-88)) ANALYSIS OF A REACTIVITY INSTABILITY EXPERIMENT WITH BOILING AND NONLINEAR ANALYSIS OF SPATIAL STABILITY AND

FLUX TILT TRANSIENTS. J. N. Grace. Westinghouse Electric Corp. [Bettis Atomic Power Lab.], Pittsburgh.

Two methods of analysis of boiling reactor stability were developed and tested experimentally. One can be carried out by hand calculation and is suitable for survey studies. The other employs a large computer and provides accurate results expediently. Both methods employ parametric values obtained from theory and from out-of-pile experiments. The essentials of these methods of analysis are explained, and the results of an experiment designed to test the theory are described. (W.D.M.)

3597 (ANL-6205(p.189-96)) THE DYNAMICS OF LARGE BOILING REACTORS. E. S. Beckjord and W. H. Harker. General Electric Co. [Atomic Power Equipment Dept.], San Jose, Calif.

Reactors having core dimensions that are large compared to the neutron migration length have a freedom in spatial flux distribution not present in small reactors. Spatial flux oscillations driven by xenon were studied in detail by various authors. Unfortunately, the eigenvalue expansion technique used obscured the role of the operator in causing the oscillations. The operator's decisive part in causing these oscillations is demonstrated. (W.D.M.)

3598 (ANL-6205(p.201-13)) OSCILLATOR TESTS IN BRITISH FAST REACTORS. A. R. Baker. United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

The oscillator experiments performed in the zero-power fast reactors, Zeus and Zephyr, are described. Brief mention is made of the experiments proposed for the 60-Mw Dounreay Fast Reactor. A description of an experiment to measure the Doppler effect is included because it requires the same type of equipment as oscillator tests of stability and because the Doppler effect, if large, is an important contributor to the power coefficient. (W.D.M.)

3599 (ANL-6205(p.214-18)) PROGRESS IN FREQUENCY RESPONSE MEASUREMENTS AT LOS ALAMOS. PART I. R. M. Kiehn. Los Alamos Scientific Lab., N. Mex.

Results of zero-power transfer function measurements made at Los Alamos for a number of different reactor assemblies are given. The results, some of the measurement techniques, and some of the problems involved in making the measurements are discussed. (W.D.M.)

3600 (ANL-6205(p.219-31)) PROGRESS IN FREQUENCY RESPONSE MEASUREMENTS AT LOS ALAMOS. PART II. E. O. Swickard. Los Alamos Scientific Lab., N. Mex.

A description of a reactor oscillator being used at Los Alamos to determine zero-power transfer functions of plutonium systems is given. The purpose of the analyzer is to apply a small sinusoidally varying δk of known magnitude to a reactor and measure the amplitude of N_1/N_0 and the phase angle between δk and δn. The frequency range over which the analyzer was designed to operate is from 0.01 to 10 cycles per second. (W.D.M.)

3601 (ANL-6205(p.232-49)) RECENT EBR-I STABILITY STUDIES. R. R. Smith. Argonne National Lab., Idaho Falls, Idaho.

The nature of the problems which existed in the earlier EBR-1 loadings is briefly reviewed. The experimental program was divided into two phases: one dealing with the fully ribbed rigid core and the other dealing with various configurations in which stabilizing ribs were removed. Transfer function measurements were carried out at various power levels to test the linearity of the feedback. (W.D.M.)

3602 (ANL-6205(p.251-68)) ANALYSIS OF THE POWER FEEDBACK RELATIONS IN FAST REACTORS. F. Storrer. Atomic Power Development Associates, Inc., Detroit.

A method that APDA proposes to use in the analysis of results of Fermi Fast Reactor oscillator tests is described. The method provides a quick and easy check on the agreement between experimental and predicted feedback characteristics. It is illustrated by an analysis of some of the experimental data obtained from the EBR-1 Mark III tests. A simple stability criterion is presented which indicates without lengthy calculations that the Fermi Reactor will be stable. (W.D.M.)

3603 (ANL-6205(p.269-77)) KINETICS STUDIES ON EBR-I AND EBR-II. PART I. D. Okrent. Argonne National Lab., Ill.

Calculations performed in the course of kinetic studies of EBR-1 and EBR-2 are discussed. The relatively good agreement between experiments on bowing effects and calculations that were made is briefly discussed. (W.D.M.)

3604 (ANL-6205(p.278-9)) KINETICS STUDIES ON EBR-I AND EBR-II. PART II. H. H. Hummel. Argonne National Lab., Ill.

The thermal feedback (the response of the reactor to unrestrained thermal expansion) is considered. Calculation of the temperature distribution in the reactor and the reactivity change associated with expansion of its various parts are discussed. (W.D.M.)

3605 (ANL-6205(p.283-93)) DETERMINATION OF IRRADIATED FUEL CROSS-SECTIONS BY REACTOR MODULATION. D. S. Craig. Atomic Energy of Canada Ltd., Chalk River, Ont.

A program to measure the change of reactivity of fuels with irradiation is described. Measurement involves oscillating samples, irradiating them, and then remeasuring their reactivity effect on the reactor. A reactivity-measuring facility was built at Chalk River for the program, and the essential features of the system, analysis of the signal, sample carrier, and accuracy are discussed. (W.D.M.)

3606 (ANL-6205(p.294-7)) THE AETR OSCILLATOR SYSTEM. H. A. Morewitz and S. G. Carpenter. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A "square-wave" oscillator experiment to be performed on the Advanced Epithermal Thorium Reactor critical assembly to measure the reactivity coefficients of a variety of materials in the central test region is described. The mechanical oscillator, electronic instrumentation, and principle of operation are briefly discussed. (W.D.M.)

3607 (ANL-6205(p.308-22)) DETERMINATION OF REACTOR ZERO POWER KINETICS PARAMETERS BY FLUX NOISE ANALYSIS. C. E. Cohn. Argonne National Lab., Ill.

Some studies of the frequency spectra of the statistical power fluctuations in nuclear reactors are described. Measurements were made by exposing an ionization chamber to the reactor flux and then analyzing the fluctuations in the current signal from the chamber with a tunable band-pass filter to obtain the noise spectrum. (W.D.M.)

3608 (APEX-578) CONTROL ROD THEORIES EVALUATION BASED UPON MEASUREMENTS OF CONTROL ROD WORTHS IN SM-I-2 REACTOR ASSEMBLIES.

J. W. Zwick. General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Apr. 21, 1959. 40p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

An analysis of control-rod theories based upon the critical-experiment measurement work on SM-1-2 reactor assemblies is presented. Special emphasis is placed on partial rod insertion, off-center rods, and rings of rods. (auth)

3609 (BAW-1211) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM CRITICAL EXPERIMENT HAZARD EVALUATION. R. H. Clark and T. C. Engelder. Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va. Sept. 1960. 105p. Contract AT(30-1)-2602. OTS.

The potential hazards associated with the operation of the Spectral Shift Control Reactor (SSCR) Basic Physics Program Critical Experiments are summarized. The experimental program, in which a series of critical experiments utilizing slightly enriched (4%) UO_2 and $(U^{235} + Th)O_2$ fuel rods in a moderator consisting of mixtures of D_2O and H_2O of different concentrations, is outlined. The design of the experiment, which employs basically the same equipment that was used in previous H_2O critical experiments, is described, with particular emphasis on those minor modifications required for D_2O handling. Described in detail are operating procedures, normal operating hazards, health physics procedures, and steps to be taken in the event of unusual conditions. The Laboratory Emergency Plan and operating limitations are stated. Various accidents, which lead to ramp reactivity insertion rates of 0.01 to 0.2%/sec, are discussed. The most serious of these, resulting from the addition of pure H_2O to an assembly designed to be just critical, are shown to be less serious than a 2% step reactivity insertion. The resulting nuclear excursion leads to a maximum total-energy generation of 1010 Mw-sec and a maximum fuel temperature of 1700°C for the slightly enriched UO_2 fuel rods, and 76 Mw-sec and 850°C, respectively, for the $(U^{235} + Th)O_2$ rods. In neither case does the cladding rupture, but there is a slight possibility that some end caps may come loose. Using conservative assumptions all fission products associated with an energy generation of 30 Mw-sec may be released from the fuel rods with the environmental hazards which are shown to be less serious than those associated with the Nuclear Merchant Ship Reactor critical experiments previously conducted in the same facility. (auth)

3610 (BAW-616) SINGLE ROD FAST EFFECTS AND RELATED MEASUREMENTS. Glenn A. Price, Alfred P. Tierney, Henry H. Windsor, Enis Erdik, Betty Perkins, and Kenzo Sato. Brookhaven National Lab., Upton, N. Y. May 1960. 12p. OTS.

During the past five years, single-rod fast-fission factors have been measured in rods with diameters of 0.25, 0.387, 0.600, 0.750, 1.1, 1.345, 1.938, 2.898, and 3.636 in. Thermal and fast flux measurements in the rods and the surrounding graphite moderator were also carried out. A summary of these fast-fission factors is presented with descriptions of the methods used to measure them and of fast and thermal flux distributions. (auth)

3611 (CF-60-10-7) HFIR REACTOR VESSEL EXPANSION PROBLEMS. W. R. Gall. Oak Ridge National Lab., Tenn. Oct. 3, 1960. 1p. OTS.

Attached to this report is a memo by G. N. Krouse of Strum-Krouse, Inc. 5p.

Results are given of a preliminary analysis of the deflections of beam holes due to thermal expansion and internal pressure in the vessel. A partial solution of the problem is suggested. Based on preliminary pressure-temperature data the following deflections were derived: (1) movement of horizontal beam tubes = 0.046 in. and (2) movement of engineering facility tubes = 0.117 in. Vertical motion of the vessel at the horizontal beam tubes due to thermal expansion may be eliminated by locating the supports in that plane. That also will reduce the expansion at the point where the slant tubes pierce the vessel wall. (auth)

3612 (CRRP-960) EFFECTIVE CROSS SECTION VALUES FOR WELL-MODERATED THERMAL REACTOR SPECTRA (3rd Edition Corrected). C. H. Westcott. Atomic Energy of Canada Ltd., Chalk River, Ont. Nov. 1, 1960. 40p. (EANDC (Can)-4; TNCC (Can)-30; AECL-1101). AECL.

This issue supersedes the uncorrected printing of the 3rd Edition dated September 1, 1960.

Effective cross section values were calculated for well-moderated thermal reactor spectra at 20 to 1300°C. The s-factors were calculated using the epithermal cut-off functions exhibiting a maximum at just above the cut-off energy. (C.J.G.)

3613 (DP-490) CALCULATION OF REACTOR TRANSIENTS. H. Dean Brown and Duncan Randall. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C. Aug. 1960. 51p. Contract AT(07-2)-1. OTS.

A method was developed to compute the transient response of any proposed reactor system to a variety of perturbations. It was used to study the stability of a D_2O-cooled power reactor, a gas-cooled power reactor, and a D_2O-cooled test reactor. The effects of such perturbations as change in D_2O coolant flow, change in H_2O flow through the heat exchanger, change in power demand, and change in control-rod position were predicted. Reactor system variables that were studied include moderator temperature coefficient, size of heat capacity holdups in the reactor system, and direction of D_2O coolant flow. (auth)

3614 (IFA-FR-21) SUR LA VARIATION SPATIALE DU SPECTRE DES NEUTRONS DANS UN REACTEUR HETEROGNE MODERE ET REFROIDI A L'EAU NATURELLE. (Spatial Variation of the Neutron Spectrum in a Heterogeneous Reactor Moderated and Cooled by Natural Water). I. Purica, A. Stefănescu, and M. Sabău. Academia R. P. R. Institutul de Fizică Atomică, Bucharest. 1959. 13p.

A study was made of the variation of neutron temperature with the constant B (for the epithermal portion having a Fermi distribution) and of the deformation of the fission spectrum with lattice position in the reactor of the Institute of Atomic Physics, Bucharest. The reactor is heterogeneous with 10%-enriched uranium moderated and cooled by natural water. (T.R.H.)

3615 (NDA-Memo-14-114) ARTIFICIAL NEUTRON SOURCE REQUIREMENT FOR THE SUB CRITICAL REACTOR. J. DeFelice. Nuclear Development Corp. of America, White Plains, N. Y. Nov. 25, 1955. 9p.

Calculations were performed to obtain an order-of-magnitude estimate of the artificial neutron source required in the Fermi subcritical reactor. The source is needed so that the flux in the graphite shield will be sufficiently high to be measured by the flux-detecting instruments. The measurements will determine the multiplication of the reactor while it is subcritical. The problem was to determine the neutron flux 1 ft into the graphite

shield when a neutron source is placed at the center of the core with all the scram rods inserted. (W.D.M.)

3616 (NP-9423) LOCKHEED AREA MONITORING SYSTEM. E. N. Lide, L. A. Turner, R. L. Shipp, and S. K. Stephenson. Lockheed Nuclear Products, Marietta, Ga. Apr. 1960. 121p. (NR-78R). OTS.

A unique system for monitoring radiological hazards was developed for use at the Radiation Effects Reactor. In this system, a single, inexpensive twin lead is run from the central recording station to each remote station. Each twin lead carries primary power and channel-selecting signals from the central to its associated remote station and carries radiation analog signals from the remote station back to the central station for recording. All remote instrumentation is transistorized (with the exception of two electrometer tubes) and buried underground to minimize temperature variations. (auth)

3617 (TID-7588(p.1-15)) TECHNIQUES FOR MEASURING REACTOR NEUTRON SPECTRA. J. B. Trice. General Electric Co. [Aircraft Nuclear Propulsion Dept.], Cincinnati.

Several methods for measuring neutron flux and neutron energy spectra in and around reactors are discussed. These include proton recoil spectroscopy, crystal spectroscopy using thallium-activated lithium iodide, photographic plates and emulsions, and activation analyses. For irradiation tests in high-flux intensity reactors where space is severely limited and γ intensity is high, activation analysis appears to offer the best means for determination of the irradiation test flux environment. Techniques of activation analysis are reviewed under the subjects of thermal flux monitors, fission detectors for both thermal and high-energy neutrons, charged particle neutron-proton and neutron-α reactions, neutron-neutron (n, n^1 and n, 2n) reactions and resonance reactions. Practical methods are presented for optimum use of these reactions in obtaining the required information concerning the test environment. Instrumentation available is reviewed and advantages and disadvantages are assessed. Five methods of analyses of activation data are briefly described that range from the simplest calculations required for minimum information to the most complex methods that, with the aid of high-speed electronic computing machines, reproduce incident spectra with high-energy resolution. Procedures are recommended for tailoring the requirements of the experiment to the experimental and analytical methods available. (auth)

3618 (TID-7588(p.233-6)) PARTICIPATION OF THE INSURANCE INDUSTRY IN THE NUCLEAR ENERGY FIELD. Wayne G. Henderson. Travelers Insurance Co., Hartford, Conn.

Training of insurance company engineers to meet the needs of insurance in the nuclear field is discussed. Problem areas in adequate safety inspections are considered. (W.D.M.)

3619 (UCRL-5887) TRANSIENT THERMAL STRESS IN TUBULAR REACTOR ELEMENTS. LaMar I. Deverall. California. Univ., Livermore. Lawrence Radiation Lab. Sept. 1960. 21p. Contract W-7405-eng-48. OTS.

For presentation at the 1960 winter annual meeting of the American Society of Mechanical Engineers, Nov. 27–Dec. 2, New York City.

A theoretical solution is developed for the transient thermal-stress distribution in a reactor fuel tube of circular cross section with spatially uniform internal power generation and forced convective heat transfer at the inner surface of the tube. Solution of the equation of heat conduction is done by means of the Laplace transform with subsequent application of the inversion integral to arrive at a final expression for the transient temperature distribution. The solution is of interest in the analysis of transients in reactors that use either a gas or a liquid heat-transfer medium. The work was initiated in conjunction with the quench testing of ceramic fuel elements for a gas-cooled reactor. Expressions for the component stresses are given explicitly and examples of application of these formulas to startup of a gas-cooled reactor and the flow quenching of a fuel tube are given. (auth)

3620 (UCRL-6070) PULSED NEUTRON MEASUREMENT OF CONTROL ROD WORTHS. O. C. Kolar and F. A. Kloverstrom. California. Univ., Livermore. Lawrence Radiation Lab. Aug. 25, 1960. 24p. Contract W-7405-eng-48. OTS.

Reactivity measurements made by the pulsed neutron technique were compared with results obtained by conventional techniques. The pulsed neutron results were in good agreement with those obtained by stable period measurement and rod drop. Differential effectiveness of partially inserted rods was shown to be well represented by elementary perturbation theory. Finally, the pulsed neutron technique was found to be the only good method for measurement of large reactivity changes. (auth)

3621 (WAPD-BT-20(p.73-81)) APPLICATION OF SPHERICAL HARMONICS METHOD TO REACTOR PROBLEMS. E. M. Gelbard. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

Techniques are described for solving the spherical harmonics equations in various geometries. The spherical-harmonics method is compared with the S_n method, and it is pointed out that the use of the spherical-harmonics method is advantageous in many cases. In conclusion, an approximate form of the spherical harmonics equations is developed, and applications of this approximate form are discussed. (auth)

3622 (WAPD-T-1059) SIMULATION OF PROMPT-CRITICAL EXCURSIONS IN WATER-MODERATED REACTORS. W. A. Vogele and S. O. Johnson. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh. Sept. 1959. 72p. Contract AT-11-1-GEN-14. OTS.

A method for calculating the behavior of water-cooled reactors during prompt-critical excursions by means of an analog computer was developed. Results were obtained for a plate type zirconium clad core and for the SPERT I core. The results of the SPERT analysis were in good agreement with the experimental data. (auth)

3623 (WAPD-T-1165) TRANSPORT FLUX PEAKING CALCULATIONS IN A FUEL CELL. J. A. Davis and E. M. Gelbard. Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh. Apr. 1960. 15p. Contract AT-11-1-GEN-14. OTS.

For presentation at the June 1960 Meeting of the American Nuclear Society.

The flux-peaking problem associated with the presence of a water hole in a two-dimensional situation is solved in a diffusion approximation with one thermal neutron group. The fuel bundle external to the water hole is generally homogenized, whereas the water hole remains explicit. The magnitude of the transport corrections in the resulting cell calculation is considered. (W.D.M.)

3624 (WAPD-T-1191) AN ACCURATE CONTROL ROD POSITION INDICATOR SYSTEM. M. N. Palmer and H. A. Morewitz. Westinghouse Electric Corp. Bettis

Atomic Power Lab., Pittsburgh. May 1960. 15p. Contract AT-11-1-GEN-14. OTS.

For presentation at AIEE Pacific General Meeting, August 1960.

A control-rod position-indicator system for experimental zero-power nuclear reactors is described. The system combines servomechanism practices and analog-to digital conversion techniques and provides non-ambiguous in-line digital display with an accuracy of ±0.001 in. over a 72-in. control-rod travel. A printed record of control-rod positions can be made of manually selected rods or all rods can be automatically scanned in sequence and their positions recorded. (auth)

3625 THEORY OF HETEROGENEOUS REACTOR HAVING CYLINDRICAL BLOCKS OF FINITE RADIUS. A. D. Galanin. Atomnaya Energ. 9, 89-97(1960) Aug. (In Russian)

A theory is developed for a reactor composed of cylindrical finite blocks of small radius. The densities of thermal neutrons inside the blocks and in the moderator are determined, considering azimuthal dependences. Diffusion theory is adapted to the entire reactor volume. Simple expressions for the diffusion length in parallel and perpendicular directions are derived with a precision up to the first power of the block-and-cell ratio. It is shown that the mean scattering length in the perpendicular direction depends on the shape of the blocks. A simple method of adjusting the diffusion tensor for weak absorption and large distances between the blocks is discussed. (tr-auth)

3626 CHEMICAL STABILITY OF DEPOSITS AND TRANSPORT OF RADIOACTIVE MATERIAL IN WATER AND STEAM IN A WATER–STEAM LOOP IN THE FIRST SOVIET POWER STATION. P. N. Siyusarev, G. N. Ushakov, O. V. Starkov, L. A. Kochetkov, L. N. Nesterova, and V. Ya. Kozlov. Atomnaya Energ. 9, 98-103(1960) Aug. (In Russian)

The physico-chemical properties of radioactive deposits and methods for decontaminating the inside surfaces of pipes and turbines are analyzed. Radio-element transport processes in a steam and water loop installed in the first atomic power plant are studied. The coefficient of deposition inside the pipe and the chemical stability of the deposits were determined. Decontamination problems are discussed. (tr-auth)

3627 A RADIATION-SOURCE NUCLEAR REACTOR. Yu. S. Ryabukhin and A. Kh. Breger. Atomnaya Energ. 9, 132(1960) Aug. (In Russian)

A preliminary evaluation was made of heat and neutron balance in the radiation-source reactor (10 to 25% enriched uranium with graphite or beryllium moderator and liquid gallium-indium (16.5 at. % In) alloy as a γ source). The heterogeneous uranium-graphite reactor with 20% fuel enrichment and 20 Mw thermal capacity may be cooled with 40 liters of the above alloy. The radiation capacity of the circuit (with the maximum economy of gallium-indium alloy) is ~40 kv (equivalent to 4×10^6 g equivalent Ra). Using the γ radiation from the circuit and considering G = 1000 mol/100 ev = 12 kg/kv·hr, the reactor efficiency with total absorption of the emitted energy in ethylene would be 4400 tons of ethylene per year (at a cost of 200 million rubles). (R.V.J.)

3628 NEUTRON-FLUX DISTRIBUTION IN A HOMOGENEOUS BOILING-WATER REACTOR. B. Z. Torlin. Atomnaya Energ. 9, 257-61(1960) Oct. (In Russian)

A calculational method for boiling homogeneous reactors with variable axial neutron flux distribution was analyzed in diffusion and age approximation. The solution for a cylindrical reactor is reduced to elliptic integrals. It is found that for a reactor with a radius considerably exceeding its height, the solution can be expressed by elementary functions. (tr-auth)

3629 EFFECTIVENESS OF A SYSTEM OF ROD ABSORBERS IN A REACTOR FITTED WITH A REFLECTOR. V. I. Nosov. Atomnaya Energ. 9, 262-9(1960) Oct. (In Russian)

Two-group approximations were developed for the critical conditions and neutron flux distribution in homogeneous thermal reactors with rod absorbers. The rods extend to the bottom of the reactor and are placed along the periphery of the active zone or the radial reflector at equal distances. The results of the calculations are included. (tr-auth)

3630 NUCLEAR PHYSICAL MEASUREMENTS IN REACTORS. E. Schrüfer (Allgemeine Elektricitäts-Gesellschaft, Heiligenhaus, Ger.). Atomwirtschaft 5, 441-4(1960) Oct. (In German)

For the monitoring of all reactor types, nuclear measurement instruments are necessary. These are used for the measurement of the neutron flux, for the monitoring of fuel elements and circulatory systems, and for radiation-protection measurements. The measurement problems occurring are briefly described, and the instruments suitable for the measurements are indicated. (tr-auth)

3631 THE APPLICATION OF CONVENTIONAL MEASUREMENT APPARATUS IN NUCLEAR REACTORS. E. Schrüfer (Allgemeine Elektricitäts-Gesellschaft, Heiligenhaus, Ger.). Atomwirtschaft 5, 445-8(1960) Oct. (In German)

In addition to the nuclear measurements which must be made in a reactor, conventional measurements such as temperature, pressure, flow-through, and level are necessary. The instruments used for these measurements are described, and the specifications which they must meet for use in reactors are summarized. Methods for transmitting the measurements to recorders are also considered. The safety system is briefly considered. (J.S.R.)

3632 THE CONSTRUCTION OF A MONITORED TWO-OUT-OF-THREE SYSTEM FOR THE PROTECTION OF NUCLEAR REACTORS. N. Hemmer and H. Wilimzig (Siemens & Halske A. G., Karlsruhe, Ger.). Atomwirtschaft 5, 449-57(1960) Oct. (In German)

A high level of safety in the operation of reactors can be guaranteed by carefully conceived and adapted monitoring systems. For the fulfillment of this requirement, a "two-out-of-three" system was planned for which new apparatus with long life expectancy was developed, and simple, inherently safe circuits were constructed. (auth)

3633 SOME FRENCH EXAMPLES OF REACTOR INSTRUMENTATION. J. Weill, P. Desneiges, and E. Picard (Commissariat à l'Énergie Atomique, Saclay, France). Bull. inform. sci. et tech. (Paris) No. 42, 11-16(1960) July-Aug. (In French)

Control instrumentation in France has developed along the three following lines: transistorization, obtention of digitalized information on reactor operation, and increase of equipment safety. New instruments developed along these lines are described, and their performances are given. Special emphasis is given to burst slug detection. The instrumentation in EDF-2 for this purpose is briefly described. The monitoring apparatus necessary in a nuclear power plant is also considered. (tr-auth)

3634 THE SIMULATION OF REACTOR START UP ON ELECTRONIC ANALOGS. B. Ya. Kogan. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Energet. i Avtomat., No. 4, 36-47(1960) July-Aug. (In Russian)

A discussion of the kinetic equations of a reactor is followed by description of the methods of simulating these equations on electronic analogs. The great range of values over which neutron flux density varies is overcome either by dividing the range into steps, each of which is simulated individually or by transforming the equations to logarithms of the variables. Schematic diagrams and sequences of operation are given. The components required to construct the analog are described. A comparison is given of values of neutron density as obtained by a digital computer, an analog with electronic multiplication, and an analog with electromechanical multiplication. It is shown that the analog with electromechanical multiplication yields results that agree more closely with results yielded by the digital computer. The time interval surveyed was 900 sec. The method of logarithmic transformation, based on solution of the kinetic equations in terms of the reciprocal of reactor period, is discussed, and schematics are given for this method. Diodes are used to transform to logarithms. It is concluded that the method of solution in steps, with automatic transfer of the analog from one step to the succeeding step, yields greater accuracy than the method of logarithmic transformation. (TTT)

3635 HEAVY WATER. FRENCH RESEARCH AND PROCESSING. F. R. Paulsen. Nuclear Energy, 471-3 (1960) Oct.

The problems involved in the use of D_2O in reactors are outlined, and some of the possibilities for solving them are discussed. The problems fall into five groups: induced radioactivity, radiolysis, pollution, corrosion, and manufacture. A summary of the possible reactions in D_2O, which is 0.2% in H_2O, is given; it is concluded that induced radioactivity will present few problems. Radiolysis, on the other hand, is troublesome, since valuable deuterium is lost. The hydrogen yields from H_2O are tabulated for various types of radiations. A plot of hydrogen yield vs. resistivity indicates that the yield is a function of the water purity, and halogen ions were found to have a very marked effect on radiolysis. In the French EL-1 and EL-2 reactors, the deuterium liberation amounts to only 120 to 140 cm^3/kw-hr at the most, and the gas pressure tends to become constant after a certain time. At hydrogen pressures of 2 kg/cm^2 radiolysis practically ceases. However, this method of suppressing radiolysis is impracticable in boiling water reactors, and the decomposition gases are usually recombined in a catalyst chamber. It would be desirable to reduce radiolysis in power reactors because it absorbs some of the produced energy, and it was found that cupric ions could activate hydrogen to recombine, so that gas evolution can be reduced by 90%. In suspension type homogeneous reactors, radiolysis was found to decrease with the size of the suspended particles, but there is a limit to the extent to which the size can be increased. Pollution of D_2O will give higher induced radioactivity and increased radiolysis, and some of the impurities, e.g., boron, may have a high neutron capture cross section. Also, if a large amount of H_2O is present, it will exchange with D_2O, giving HOD and deuterium gas. Thus it is important to keep D_2O pure. Corrosion by D_2O would be similar to that by H_2O; so there probably will be no new problems. Many methods of manufacture were considered for use in France, but isotope exchange reactions were chosen. It is anticipated that substitution of NH_3 for H_2S in the H_2S-H_2O exchange reaction will improve the exchange. (D.L.C.)

3636 HARWELL'S SPENT FUEL PONDS. Nuclear Power 5, No. 55, 95(1960) Nov.

Radioactivity decay from the Dido and Pluto spent fuel elements is being used as a high-energy γ source for experimental and industrial applications. With an expected maximum activity of 2 million curies, this facility has an interesting potential for such uses as the sterilization of surgical appliances, soils and foodstuffs; the polymerization of rubber, and raising the melting point of polythene. It is being currently used for performance evaluation of lubricating oils and greases subject to certain nuclear conditions. (auth)

3637 NUCLEAR REACTORS. Bibliographical Series No. 2. Peter I. Nikitin and Sergei G. Rodovnichenko, comps. International Atomic Energy Agency, Vienna. 1960. 724p. $5.00.

A bibliography of 4118 references is presented on reactors; English or Russian descriptive abstracts are given for most references. The bibliography covers the most important literature sources for the period 1947 to 1959 and is classified into ten categories: (1) general; (2) nuclear power programs; (3) reactor theory and physics; (4) research, test, and experimental reactors; (5) power reactors; (6) nuclear power plants and equipment; (7) reactor components, materials, and engineering; (8) reactor control, operation, and instrumentation; (9) shielding and reactor safety; and (10) economy of power reactors and plants. An author index is included. (D.L.C.)

3638 BOILING VS NON-BOILING LIQUID METAL COOLED REACTORS. David L. Cochran and Keith E. Buck (Aerojet-General Nucleonics, San Ramon, Calif.). Paper No. 1340-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 16p.

The relative merits of boiling and nonboiling reactors for use in Rankine Cycle space power plants over the power level range of from 1 to 20 Mw(e) are evaluated. A lithium-cooled fast reactor is most attractive for the nonboiling system, and a potassium-cooled boiling fast reactor is most attractive for the boiling system. Potassium is the cycle working fluid in each system. A turbine inlet temperature of 2000°F and shielding weights commensurate with manned applications are assumed. It was found that unless risks in reactor safety are accepted in the boiling reactor system, the nonboiling reactor system is more attractive in terms of size and weight. The weight savings resulting from such risks in the boiling system are only marginal and may actually be nonexistent. The nonboiling reactor does not have the uncertainties caused by boiling in the core, and its development would be cheaper and less involved. Experimental data on boiling flow, heat transfer, and pressure drop are required to determine the relative desirability of the boiling reactor system. (auth)

3639 IMPROVEMENTS RELATING TO ELECTRICAL POSITIONAL CONTROL APPARATUS. Leslie Carter Ludbrook and John Pearson Gregory (to British Thomson-Houston Co., Ltd.). British Patent 842,458. July 27, 1960.

An electric positional control apparatus is designed for reactor control rods so that the required amount of control apparatus is reduced. The apparatus includes a plurality of positional-type motors, a low-frequency a-c voltage generator, and a control circuit that connects the motors individually or in groups to the generator. The motors are of the winding type for raising or lowering a load. Circuit diagrams of the apparatus are given. (D.L.C.)

3640 NEUTRON AMPLIFIER. (to Dow Chemical Co.) British Patent 850,876. Oct. 12, 1960.

A thorough description is given of the design, operation, and possible variations of a neutron amplifier for controllable neutron outputs produced by subcritical chain reactions. The amplifier comprises a cascaded series of stages consisting of fissionable fuel cells separated from each other by neutron moderator walls. In operation a neutron source is positioned at one end of the cascade; a fission reaction is induced by the source in the first cell, producing more neutrons which then serve to induce a fission reaction in the second cell, etc. The fissionable fuel is solid U^{235} or a solution of $UO_2(NO_3)_2$ or UO_2SO_4 and the moderator is usually D_2O. Characteristic data are given for all the possible fuel and moderator materials. Various methods are described for using feedback to stabilize the amplifier at a given neutron generation level so that it will be self-sustaining when the neutron source is withdrawn. Two of these methods are (1) passing neutrons backward from one stage into the previous stage to induce more fission reactions and (2) transferring the fuel material (where it is fluid) of one stage into a preceding stage. The possible use of control rods to enhance or lessen the fission reaction is discussed. An amplifier design with concentric spheres is included together with drawings for all the designs. (D.L.C.)

3641 IMPROVEMENTS RELATING TO HEAT INSULATION. Ronald Frank Bishop, Frank Clifford, and Ronald Ernest Bucknell (to Whessoe Ltd.). British Patent 851,458. Oct. 19, 1960.

A durable thermal insulation material, suitable for reactor pressure vessels, comprises a plurality of thin metal sheets spaced apart by means of corrugations or spacers on each alternate sheet and held in place against the vessel wall by thick cover plates. Neutron heating of the pressure vessel can be reduced to ~60% by use of mild steel cover plates 1-in. thick, and this reduction can be increased still further by use of boron steel clad with mild steel. (D.L.C.)

3642 WATER-COOLED NUCLEAR REACTORS. (to Brown, Boveri & Cie, A. G.). British Patent 854,291. Nov. 16, 1960.

A boiling-water reactor can be designed so that the water does not moderate neutrons and hence the reactor breeding efficiency can be increased. This is done by producing the fuel elements from a mixture of fuel, moderator, and breeder material (e.g., beryllium oxide, thorium oxide, and U^{233} oxide), and reducing the distance between the fuel elements in the reactor. (D.L.C.)

Power Reactors

3643 (ANL-6217) SOME CALCULATIONS FOR A PLUTONIUM-FUELED ZPR-III. A. R. Baker. Argonne National Lab., Ill. Sept. 1960. 25p. Contract W-31-109-eng-38. OTS.

Calculations of critical size, reactivity coefficients, and delayed neutron fractions are described for mockups of a plutonium-fueled EBR-I (Mark IV) and five possible metal-fueled power reactors. The calculations for critical size were performed using the SNG transport-theory code. The reactivity coefficients were estimated by SNG calculations or by one-group perturbation-theory desk calculations. The delayed-neutron fractions were estimated by an approximate method, which starts with a calculation of β for a bare core and then makes a correction for the small effect of the blanket. The reactivity effects studied were the effects of fuel-plate and whole-core expansion and control-rod worths. (auth)

3644 (APAE-2(Rev.1)) HAZARDS SUMMARY REPORT FOR THE ARMY PACKAGE POWER REACTOR SM-1, TASK XVII. S. S. Rosen, ed. Alco Products, Inc., Schenectady, N. Y. May 1960. 260p. Contract AT(30-3)-326. OTS.

The SM-1 is described and the various hazards are reviewed. Because of the reactor's location near the nation's capital, containment is of the utmost importance. The maximum energy release in any possible accident is 7.4 million Btu which is completely contained within a $\frac{7}{8}$-in.-thick steel cylindrical shell with hemispherical ends. The vapor container is 60 ft high and 32 ft in diameter and is lined on the inside with 2 ft of reinforced concrete which provides missile protection and is part of the secondary shield. All possible nuclear excursions are reviewed. The energy from any of these is insignificant compared to the stored energy in the water. The maximum credible accident is caused by the reactor running constantly at its maximum power of 10 Mw and through an extremely unlikely sequence of failures, causing the temperature of the water in the primary and secondary systems to rise to saturation, whereupon a rupture occurs releasing the stored energy of 7.4 million Btu into the vapor container. If the reactor core melts during the accident, a maximum of 1.5×10^7 c of activity is released into the vapor container. While it is highly improbable for a rupture of the vapor container to occur except by sabotage or bombing, the hazards to the surrounding area are discussed in the event of such a rupture occurring simultaneously with the maximum credible accident. The SM-1 has been in operation for about 3 years, during which time much operating experience was accumulated and nuclear and system data were obtained through both normal operations and the research and development programs conducted. These data are discussed in relation to their effect on the hazards evaluation of the SM-1 and include core nuclear data, primary and secondary system thermal data, radiological safety, dose rates at various positions in the primary system both during operation and after shutdown and their effects on maintenance, experience with radioactive-waste disposal, area monitoring, experience with the use of trainees in plant operation, and plant modifications accomplished during this period. During 3 years of operation, SM-1 has proved to be an extremely stable and safe system. No incidents occurred during this time that resulted in any significant injuries, radiation exposures or environmental contamination. A plan is included for continued operation of the SM-1 facility after July 1, 1960, when SM-1 will become the responsibility of the U. S. Army Corps of Engineers. (auth)

3645 (APAE-71) ANALYSIS OF ZERO POWER EXPERIMENTS ON SM-1 CORE II AND SM-1A CORE I. S. Paluszkiewicz. Alco Products, Inc., Schenectady, N. Y. Oct. 5, 1960. 45p. Contract AT(30-3)-326. OTS.

An analysis of SM-1 Core II and SM-1A Core I zero power experiments was made by comparing these cores to each other and to SM-1 Core I on the basis of critical bank positions, bank calibrations, and available chemical analyses of the fuel-plate compositions. The effects of replacing boron absorbers by europium absorbers upon rod worth and stuck rod conditions were studied. Comparisons of measured and calculated power distributions were made. It was concluded that both SM-1 Core II and SM-1A Core I contain nearly identical B-10 loadings of 17.79 grams, compared to the best estimate of 15.75

grams for SM-1 Core I. The available data indicate that all three cores possess similar nuclear characteristics. (auth)

3646 (APAE-Memo-276) SM-1—RESEARCH AND DEVELOPMENT QUARTERLY REPORT [FOR] APRIL 1 TO JUNE 30, 1960. C. A. Bergman, W. S. Brown, R. A. Hasse, et al. Alco Products, Inc., Schenectady, N. Y. Sept. 20, 1960. 171p. Contract AT(30-3)-326. OTS.

With the exception of a brief period of slightly elevated chloride level in the secondary blowdown, water-chemistry conditions during the period were satisfactory. During the period, the reactor was shut down for end-of-core-life testing and rearrangement. A set of specifications covering all electronic and electromechanical mechanisms required to control the SM-1 reactor through the rod-drive motors and clutches was prepared and issued. Installation of instrumentation for plant response and system performance was virtually completed. Work on the interpretation of long-lived radiochemical data obtained at the SM-1 during core lifetime was continued. Analysis of all fission-product data collected during Core I life has started. Thirty-eight stationary and seven control subassemblies from SM-1 Core II were checked for α contamination by a gas-flow proportional-counting technique. The work on the final design of a waste-disposal system for SM-1A was stopped and an investigation of an interim system containing a bypass sampling system was undertaken. Work continued on tests 202, 203, and 204 in the activity-buildup phase of Test Series 200. Core-physics measurements were taken at end of Core I life to complete the series of measurements made throughout the lifetime of the core. (W.L.H.)

3647 (BAW-41(Rev.1)) FUNCTIONAL DESIGN ANALYSIS OF THE PRESSURIZER FOR THE CONSOLIDATED EDISON THORIUM REACTOR PLANT. S. H. Esleeck. Babcock and Wilcox. Atomic Energy Div., Lynchburg, Va. Dec. 1957. Revised June 1960. 48p. For Consolidated Edison Co. of New York, Inc. OTS.

The Consolidated Edison Thorium Reactor pressurizer system and its related design and operating data are described. The pressurizer design and size are based on the maximum expected power transients of 50 Mw(e) steps, increasing or decreasing, and a turbine trip and reactor scram from full-power condition. The pressurizer recommended is a vessel that has a volume of 460 ft^3 and uses a spray to retard pressure buildup resulting from a large reactor coolant water expansion. The design is based on consideration for safe reactor coolant-system operation and control. (auth)

3648 (BAW-85(Rev.1)) THE EFFECTS OF FUEL ROD FISSION PRODUCT LEAKAGE ON THE CONSOLIDATED EDISON THORIUM REACTOR PLANT. D. W. Montgomery, J. O. Howard, and R. H. Dodd. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Nov. 1958. Revised June 1960. 51p. For Consolidated Edison Co. of New York, Inc. OTS.

Experiments performed by WAPD and others showed that with fuel in an oxide form, it is possible to continue to operate a nuclear plant with fuel rods that have developed defects with only a small increase in the radiation contamination problem. A system of equations is developed based on the assumptions used in the original experimental measurements. By the utilization of these equations and experimental constants measured for UO_2 fuel, the expected activities of radioactive fission products in the primary coolant, purification, and waste disposal systems are determined. To determine the design radiation levels and shielding thicknesses, it becomes necessary to scale the activities calculated in the report. The method selected is to choose a maximum radiation level outside the primary loop of 100 mr/hr. This level, combined with the expected activity distribution from a unit fuel source leaking (in this case 1000 g), yields a scale factor. All other activities are then multiplied by this factor and used as sources to compute shielding thicknesses and radiation levels. (auth)

3649 (BAW-116(Rev.1)) CONSOLIDATED EDISON THORIUM REACTOR HOT EXPONENTIAL EXPERIMENT. R. H. Clark, L. G. Barrett, and J. M. Funderburg. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Mar. 1960. Revised June 1960. 64p. For Consolidated Edison Co. of New York, Inc. OTS.

A series of exponential experiments was performed using Consolidated Edison Thorium Reactor oxide type fuel pins in a light-water lattice. Measurements were made at temperatures up to 468°F in the presence of various concentrations of boric acid. The main objective of these experiments was to obtain the change in material buckling for the system as operating conditions were changed from ambient to high temperature. A supplementary series of experiments was performed using a mock-up of the canned CETR core. In these experiments thermal neutron-flux traverses were made under ambient and hot conditions through a control blade, rod follower, and water gap. (auth)

3650 (BAW-119(Rev.1)) CONSOLIDATED EDISON THORIUM REACTOR CRITICAL EXPERIMENTS WITH OXIDE FUEL PINS. M. L. Batch and N. L. Snidow. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. July 1960. 173p. For Consolidated Edison Co. of New York, Inc. OTS.

Critical experiments with pin-type oxide fuel elements for the CETR are described. These experiments were conducted to provide data on the infinite medium properties of the lattice inside the canned elements in the various CETR loading zones and to obtain specific information on the full-size CETR core. Measurements are described and results are interpreted. (J.R.D.)

3651 (BAW-120(Rev.1)) CONSOLIDATED EDISON THORIUM REACTOR PHYSICS DESIGN. H. S. Barringer, R. B. Flickinger, and S. W. Spetz. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Mar. 1960. Revised July 1960. 169p. For Consolidated Edison Co. of New York, Inc. OTS.

The nuclear characteristics of the CETR are described. Core operating lifetime, control-rod worth, and power-density distribution are discussed in relation to maximizing the core operating life. Other objectives of nuclear design are to minimize the power-density variation and to assure control of the reactor. (J.R.D.)

3652 (BAW-132) THERMAL AND HYDRAULIC DESIGN OF THE CONSOLIDATED EDISON THORIUM REACTOR. J. K. Ferrell, H. E. Flora, D. R. Hostetler, L. J. Stanek, and W. M. Vannoy. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. July 1960. 69p. For Consolidated Edison Co. of New York, Inc. OTS.

The thermal and hydraulic analyses, both steady state and transient for the CETR are presented. Methods of calculations are discussed and results of analyses are presented. Steady-state analyses are included for pressure drops, flow distribution, orificing, burnout, fuel

central melting, local boiling, and bulk boiling. Transient analyses are included for several loss of forced coolant flow incidents. Fuel melting during steady-state operation and burnout cannot occur at any attainable reactor power in the CETR as designed. Bulk boiling of the coolant does not occur at any point in the core during normal steady-state operation. Bulk boiling is permitted during transients because very few fuel channels are involved and the resulting effects on over-all reactor performance are small. Local boiling of the coolant may occur in the reactor during normal steady-state operation and has no appreciable effect on reactor operation except a slight increase in friction pressure drop. The heat-transfer characteristics of the core are actually improved. The hydraulic transient analyses show that no risk of core damage exists for the total loss of forced coolant flow from either maximum or minimum initial flow conditions. (auth)

3653 (BAW-133) FUEL ELEMENT STRUCTURAL DESIGN AND MANUFACTURE FOR THE CONSOLIDATED EDISON THORIUM REACTOR PLANT. D. M. Collings, D. K. Gestson, C. Andrea, H. D. Ferris, R. L. Boyer, and G. C. Larson. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Sept. 1960. 76p. For Consolidated Edison Co. of New York, Inc. OTS.

The design of the fuel-element structure for the CETR is described. Component parts of the assembly comprise the fuel-bundle assembly, the fuel-can assembly, the upper transition, the fuel-element spring, and the upper nozzle and seal assembly. (J.R.D.)

3654 (BAW-134) IRRADIATION TEST PROGRAM FOR THE CONSOLIDATED EDISON THORIUM REACTOR. P. B. Baker, E. J. Dzura, and C. R. Johnson. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Aug. 1960. 88p. For Consolidated Edison Co. of New York, Inc. OTS.

The Irradiation Test Program for the Consolidated Edison Thorium Reactor was conducted to obtain confirmation of the stability and performance of the reference fuel-element materials and of test assemblies under design operating conditions. Fuel-cladding specimens of type 304 stainless steel containing additions of natural boron up to 0.05 wt. % were irradiated at approximately 130°F to an integrated thermal neutron flux of 9.6×10^{19} nvt. The irradiated specimens were tested to determine mechanical properties and corrosion in borated water. Control specimens of standard 304 stainless steel were subjected to the same test conditions for comparative purposes. Test results verified the mechanical behavior and corrosion resistance to borated water of cladding material for service in the CETR. (auth)

3655 (BAW-136) CONSOLIDATED EDISON THORIUM REACTOR—REACTOR VESSEL INTERNAL COMPONENTS DESIGN. J. Ficor, D. M. Collings, R. J. Sandrock, and D. D. Kalen. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. July 1960. 46p. For Consolidated Edison Co. of New York, Inc. OTS.

The design functions and fabrication details for internal components of the CETR are presented and pertinent analytical stress studies are summarized. Functions of the internal components include proper orientation and support for the fuel elements, proper distribution of primary coolant within the reactor vessel, and the establishment of guide channels for the control rods. (J.R.D.)

3656 (BAW-137) CONSOLIDATED EDISON THORIUM REACTOR CONTROL ROD DRIVE LINE TESTING. J. A. Good and D. E. Thoren. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Aug. 1960. 132p. For Consolidated Edison Co. of New York, Inc. OTS.

A development program to evaluate the CETR control rod drive line operation is described. Test results are included which demonstrate that the perfected prototype control rod drive line, including all associated parts, satisfies the design and operating reliability requirements. (J.R.D.)

3657 (BAW-138) CONSOLIDATED EDISON THORIUM REACTOR CONTROL SYSTEM DESIGN. W. E. Carson, W. B. Chubb, R. T. Pickett, and J. C. Deddens. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Aug. 1960. 86p. For Consolidated Edison Co. of New York, Inc. OTS.

The Consolidated Edison Thorium Reactor Control System was designed to provide the operators with a reliable, safe, and accurate means of controlling the plant. Manual and automatic positioning of control rods can be accomplished. The automatic plant controller was designed to meet the design criteria under the representative CETR-demanded load changes. Adaptability was built into the plant controller by providing variable controller adjustments for variations in reactor characteristics. Extensive analog studies were made of the various plant parameters and their effect on control was carefully evaluated. These analog studies showed that the control system will perform in a satisfactory manner under the most adverse plant conditions. (auth)

3658 (BAW-142(Rev.1)) CORROSION PRODUCT ACTIVITY DISTRIBUTION ACROSS THE CHEMICAL PROCESS SYSTEM IN THE CONSOLIDATED EDISON THORIUM REACTOR PLANT. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. and Vitro Engineering Co., New York. Sept. 1958. Revised Aug. 1960. 22p. For Consolidated Edison Co. of New York, Inc. OTS.

A study was performed to determine the corrosion product and water impurity activities in the CETR Chemical Process System. These activities were calculated as functions of the reactor operating time, primary loop blowdown purification rate, and decay time following removal from the primary loop. For the design blowdown purification rate chosen, isotopes that are important to the design of radiation shielding include Co^{60} and Co^{58}, Fe^{55}, Cr^{51}, and Mn^{56}. A simplified mathematical model is used to represent the physical situation; however, the magnitude of the activities, taken at the end of core life to represent the most conservative case, is considered sufficiently accurate for engineering calculations. (auth)

3659 (BAW-144) GEOMETRIC AND TEMPERATURE EFFECTS IN THORIUM RESONANCE CAPTURE FOR THE CONSOLIDATED EDISON THORIUM REACTOR. W. G. Pettus. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Apr. 27, 1959. Revised June 1960. 35p. For Consolidated Edison Co. of New York, Inc. OTS.

Experiments conducted to reduce the uncertainty related to neutron resonance absorption in thorium are described. The experimental procedure was the determination of reactivity coefficients by measurements of reactor period in the Lynchburg Pool Reactor. Experimental procedure and apparatus are described, and results of geometric and temperature dependence are included. (J.R.D.)

3660 (BAW-147) DESIGN OF THE MOVABLE AND FIXED CONTROL COMPONENTS FOR THE CONSOLIDATED EDISON THORIUM REACTOR. D. K. Gestson,

D. M. Collings, and W. Maynard. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Aug. 1960. 29p. For Consolidated Edison Co. of New York, Inc. OTS.

Prototype testing and thorough design analyses proved that the control components for the Consolidated Edison Thorium Reactor are adequate to withstand loads imposed during operation and handling. Assumptions made in the design analyses and cycles run during prototype testing subjected the components to more rigid conditions than are anticipated during actual operation. Results indicate the control components meet their design requirements. (auth)

3661 (BAW-1092) LIQUID METAL FUEL REACTOR EXPERIMENT. DESIGN AND CONSTRUCTION OF AN IN-PILE TEST LOOP. R. A. Lee. Babcock and Wilcox Co. Research Center, Alliance, Ohio. June 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 59p. Contract AT(30-1)-1940. OTS.

As part of the Liquid Metal Fuel Reactor Experiment, a forced-circulation U–Bi loop was designed and built. A description of the loop components is given. A flow diagram is included. (C.J.G.)

3662 (BAW-1096) LIQUID METAL FUEL REACTOR EXPERIMENT. ALPHA-GAMMA ANALYTICAL FACILITIES FOR B & W RADIATION LOOP NO. 2, ETR. M. M. Rubright and N. R. Johanson. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Feb. 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 91p. Contract AT(30-1)-1940. OTS.

An investigation is under way to determine the feasibility of using Croloy $1\frac{1}{4}$ or $2\frac{1}{4}$ as the containment material for a Liquid Metal Fuel Reactor (LMFR). While nonradioactive experiments and dynamic-loop tests have been made, final evaluation must be withheld until the effects of in-pile exposure are determined. This presents a serious problem since special facilities are required to analyze in-pile loop samples because of the unique combination of high-α high-γ radiation encountered. The α radiation from Po^{210}, resulting from neutron capture by the bismuth matrix of the loop, complicates the process of analyzing the high-γ activity samples, causing many departures from standard high-activity analysis procedures. Design and testing of facilities which were to be installed in the National Reactor Testing Station for the analysis of in-pile test samples are discussed. The complete design is described in detail, along with the planned methods of analysis. Although some of the mechanisms were tested in mock-up, the facility was not completed because the program was cancelled prematurely. (auth)

3663 (BAW-1184) LIQUID METAL FUEL REACTOR EXPERIMENT, RESEARCH AND DEVELOPMENT OF REMOTE MAINTENANCE. Final Report. W. H. Maynard. Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Mar. 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 35p. Contract AT(30-1)-1940. OTS.

The development and operational testing of remotely controlled maintenance equipment for use in the Liquid Metal Fuel Reactor are described. The performance of stationary and mobile remote viewing equipment, remote handling using a mobile manipulator, remotely controlled cranes and utility vehicles, and remote-control systems is reported. (See also BAW-1136.) (C.J.G.)

3664 (BAW-1254) LIQUID METAL FUEL REACTOR EXPERIMENT. BASIC SLURRY INVESTIGATIONS. Babcock and Wilcox Co. Research Center, Alliance, Ohio. June 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 277p. Contract AT(30-1)-1940. OTS.

An investigation was undertaken to develop a slurry of insoluble thorium and uranium compounds for a single-region liquid metal fuel reactor. Chemical- and physical-stability tests were made with slurries of oxides, carbides, and fluorides of thorium and uranium in bismuth. Dynamic bench-scale and large-loop tests were made with solid solution ThO_2–UO_2 slurries. (auth)

3665 (CF-60-8-152) SUMMARY OF HRT RUN 18. H. F. Bauman, N. C. Bradley, S. R. Buxton, P. N. Haubenreich, J. O. Kolb, and D. M. Richardson. Oak Ridge National Lab., Tenn. Aug. 26, 1960. 51p. OTS.

The primary objective of Homogeneous Reactor Test run 18 (November 1958 to February 1959) was to study the effect of operating conditions on the fuel-solution stability. The chemical-plant inlet was a dip tube in the reactor core. The fuel-solution inventory was determined, first with all the fuel in the dump tanks and then with the fuel circulating and the reactor at very low power at various temperatures between 220 and 280°C. An addition of depleted uranium was made to provide an independent measurement of inventory from the isotopic ratio of U^{235} to U^{238}. Later, with the reactor temperature held near 260°C, the power was increased stepwise up to 1.6 Mw. There were several difficulties with reactor equipment, including a feed-water flange leak, the fuel-letdown valve's sticking open on one occasion, and an automatic dump of the reactor initiated by gaseous activity backing into one of the instrument lines. There were no significant activity releases. The threshold for power-dependent changes in the fuel was found to be about 0.7 Mw core power with the reactor at 260°C and 1500 psig, and with an acid-to-sulfate ratio of 0.27. The power-dependent changes, although small, were apparent in the circulating inventory, critical concentration, and nuclear average temperature. No power pips were observed. (auth)

3666 (CF-60-10-8) DESCRIPTION OF THE IBM-704 CODE FOR THE CALCULATION OF CONCENTRATION TRANSIENTS IN THE HRT. H. B. Piper and P. N. Haubenreich. Oak Ridge National Lab., Tenn. Oct. 4, 1960. 14p. OTS.

The calculation of concentration transients in the homogeneous Reactor Test caused by mixing in the interconnected three-body system of the fuel dump tanks, core, and blanket was coded for the IBM-704. The system of equations includes material balances, the dependence of critical temperature on core and blanket concentrations, and the effect of temperature (density) changes on flow rates. The controllable flow rates, the fuel dump tank weight and the initial conditions are input variables. Outputs include core and blanket concentrations, critical temperature, concentration ratio, and power ratio. (auth)

3667 (CRL-65) CANADA'S RESEARCH AND DEVELOPMENT PROGRAM FOR AN ORGANIC LIQUID COOLED NUCLEAR REACTOR. W. M. Campbell. Atomic Energy of Canada Ltd., Chalk River, Ont. Oct. 1960. 13p. (AECL-1108). AECL.

For presentation at the A.E.C. Symposium on Organic Reactors, Canoga Park, California, October 6-7, 1960.

An outline of Canada's program which is centered on the OCDR reactor design is presented. Included are discussions on coolant selection and evaluation, cooling-system heat transfer, burn-out and fouling, pressure-tube development, materials selection, fuels, general mechanical devel-

opment, and physics parameters. It is noted that the preliminary designs were optimistically accepted and a decision to proceed with the design of a reactor experiment appears likely. (J.R.D.)

3668 (CVNA-45) RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD OCTOBER 1, 1959 TO DECEMBER 31, 1959. P. G. DeHuff. Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh. Feb. 1960. 127p. For Carolinas Virginia Nuclear Power Associates, Inc. Contract AT(30-1)-2289. OTS.

Several changes were made in the pressure-tube design. The location of the Zircaloy–stainless-steel transition joint was raised to an elevation higher on the pressure tube to keep stainless steel out of the reflector region of the core. The stainless-steel portion of the pressure tube was changed from an assembly of three parts to an assembly of two parts. This was done by specifying that the stainless-steel legs be made completely from 410 stainless rather than 410 and 304 stainless as previously specified. The preparation of a thermal-cycling test facility was completed. Testing of gasketed fittings was initiated in this facility. The scheduled 2000 hr corrosion test on six control-rod materials was completed. The rolled Zircaloy–stainless-steel transition-joint design being developed by Canadian General Electric was selected as the prime alternate to the Marman Conoseal type of joint. Information received from Canadian General Electric indicated that the rolled joint appears to be very promising. Modifications were made to the thermal-baffle design, improving it and simplifying fabrication. The design of the top neutron shield was changed. The new design consists of alternate layers of heavy water and steel plates, the heavy water being obtained by raising the moderator level. To reduce the heat losses, a thermal baffle was provided around the neutron-streaming plug. However, even with this baffle, the heat loss to the moderator by conduction through the pressure-tube walls increased from 1.9 to 2.6 Mw. A Zircaloy-2 fuel-assembly support grid was satisfactorily brazed. Attempts are being made to develop methods of bonding the spiral Zircaloy spacer wire to the fuel rods. Tests to determine the degree of coolant mixing in the fuel assemblies were started in the low-pressure loop. The tests to determine the pressure drop across the fuel assemblies are approximately 70% completed. Testing to determine pressure drop across the various proposed orifice designs was started. The failed-fuel-element detection system was thoroughly investigated to determine the circumstances under which defective fuel elements can be detected. (See also CVNA-30.) (auth)

3669 (GEAP-3334) DESIGN STUDY—SODIUM MODULAR REACTOR. J. F. Cage, Jr., P. Aline, W. W. Kendall, D. B. Sherer, and B. Hutchins. General Electric Co. Atomic Power Equipment Dept., San Jose, Calif. Jan. 15, 1960. 396p. Contract AT(04-3)-189. OTS.

A study was undertaken to investigate desirable features of a sodium-cooled graphite-moderated uranium-fueled power reactor using the modular concept and to evaluate the economic potential of this reactor type. A preliminary reactor design for a 200 Mw(e) plant was developed using the highest heat-transfer properties and coolant temperatures, which appear reasonable to achieve without major improvements in reactor-coolant technology. A cost estimate was made of the preliminary design, assuming that reasonable solutions are found to key technical problems. This was combined with an estimate of the cost of an associated turbine electric plant. Results of the analysis showed 200 Mw(e) plant costs of $300/kw and fuel costs of approximately 2.3 mils/kw-hr. The program required to develop this plant is comprised of fuel development, general mechanical developments, physics work, and the design and construction of a reactor test. This program is estimated to require about five years and to cost approximately $8 million. Because graphite-moderated reactors have particularly improved neutron balances in larger sizes, data developed in this study were used to estimate the size and performance of a reactor for a 400 Mw(e) plant. It appears to have promising economics, and further investigation of it is included as a step in the development program described. (auth)

3670 (GNEC-136) A 200-Mw(e) BOILER-SUPERHEATER REACTOR PRELIMINARY DESIGN. General Nuclear Engineering Corp., Dunedin, Fla. and Combustion Engineering, Inc., Windsor, Conn. Oct. 25, 1960. 177p. Contract AT(11-1)-795. OTS.

A 200-Mw(e) nuclear-superheater reactor is described which is of the integral type; i.e., the formation of steam and the superheating of the steam are both accomplished within a single reactor core. Steam leaves the reactor at 1200 psig and 1050°F. With feedwater returned to the reactor at 450°F, the gross cycle efficiency is estimated to be 38.6%, requiring 352 Mw to be added during boiling and 166 Mw during superheating. (W.D.M.)

3671 (LA-2465) LOS ALAMOS POWER REACTOR EXPERIMENT NO. II, LAPRE II. R. A. Clark, comp. Los Alamos Scientific Lab., N. Mex. Apr. 1960. 139p. Contract W-7405-eng-36. OTS.

Design features and operating characteristics of the Los Alamos Power Reactor Experiment No. II are discussed. Results of performance tests and of an examination conducted after disassembly of the reactor are presented. Recommendations for work on uranium phosphate fueled reactors are made. (auth)

3672 (MND-LFBR-2337) LIQUID FLUIDIZED BED REACTOR EXPERIMENT. Final Report—Task 4.00. Martin R. Scheve. Martin Co. Nuclear Div., Baltimore. Apr. 1960. 147p. Contract AT(30-1)-2460. OTS.

The Liquid Fluidized Bed Reactor Experiment (LFBRE) was designed with an organic as the fluidizing-moderator medium. The purpose of the study was to develop preliminary design data in sufficient detail to enable an evaluation of the LFBRE from the following viewpoints: operating characteristics and flexibility, preliminary capital costs, preliminary operating costs, necessary research and development and site requirements, and preliminary estimate of the information to be gained from the experiment. The study was directed toward achieving the most flexible power-reactor experiment with an organic fluidized core while maintaining the lowest possible cost. (W.D.M.)

3673 (NAA-SR-Memo-3135) SEVEN ROD FUEL CLUSTER SURFACE TEMPERATURE IN SRE STORAGE CELL WITH SIMULATED DECAY HEAT. H. H. Chung and R. D. Welsh. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Oct. 10, 1958. 12p. OTS.

An investigation was conducted to determine the surface temperatures of a seven-rod fuel cluster in an SRE fuel storage cell. Electric heat was used to simulate decay heat and to determine the power that will cause the fuel surface temperature to reach the 1200°F limit. Results and recommendations are included. (J.R.D.)

3674 (NAA-SR-5350) ANNUAL TECHNICAL PROGRESS REPORT, AEC UNCLASSIFIED PROGRAMS, FISCAL YEAR 1960. Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Aug. 1, 1960. 459p. Contract AT-11-1-GEN-8. OTS.

Progress is reported on the SGR program, Hallam Nuclear Power Facility research and development, advanced OMR, Piqua Power Reactor research and development, reactor safety, separations chemistry, and advanced development. (See also NAA-SR-3850.) (W.L.H.)

3675 (NP-9324) SUPPLEMENTARY INFORMATION ON PLANT DESIGN OF CONSOLIDATED EDISON NUCLEAR STEAM GENERATING STATION. Consolidated Edison Co. of New York, Inc. Aug. 1960. 188p. Prepared in cooperation with Babcock and Wilcox Co. Atomic Energy Div. OTS.

Design information on the reactor primary systems, secondary systems, and supporting systems is presented. (J.R.D.)

3676 (NP-9359) CONSUMERS POWER COMPANY APPLICATION FOR REACTOR CONSTRUCTION PERMIT AND OPERATING LICENSE. Consumers Power Co., Jackson, Mich. 1960. 404p. OTS.

A revised hazards summary report for the Big Rock Point Power Reactor is presented. The enclosure, plant, reactor, site and environment, radioactive-waste disposal systems, operating and emergency procedures, research and development program, safeguard considerations, and safety analysis are discussed in detail. (W.D.M.)

3677 (NP-9373) PRE-OPERATIONAL ENVIRONMENTAL SURVEY OF RADIOACTIVITY IN THE VICINITY OF INDIAN POINT POWER PLANT, 1958[-1959]. Consolidated Edison Co. of New York, Inc. 82p. OTS.

The extent and results of the 1958 portion of a preoperational environmental radioactivity survey in the vicinity of the power plant are presented. The survey, started in 1958, is scheduled to be continued until the reactor is critical. Results show that the activity in the area is low. Data and soil samples are being preserved for future comparisons. (J.R.D.)

3678 ORNL-2095(Del.) DESIGN REPORT ON THE AIRCRAFT REACTOR TEST. A. P. Fraas and A. W. Savolainen. Oak Ridge National Lab., Tenn. May 1956. Decl. with deletions Oct. 19, 1959. 163p. OTS.

A design summary on the Aircraft Reactor Test is presented, comprising a fairly detailed picture of the design as it approaches completion. Changes based on information derived from component test experience, further analytical work, or fabricational developments are anticipated. (J.R.D.)

3679 (RPI-12(AECL)(Rev.)) REACTIVITY AND FUEL BALANCE IN RECYCLED PLUTONIUM REACTORS. M. F. Duret. Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont. Oct. 1955. Reprinted Sept. 1960. 25p. (AECL-1070). AECL.

The second printing reproduces the first report directly, except for minor amendments and the omission of an example dealing with a nonuniform fuel distribution in the reactor. (W.D.M.)

3680 (SRO-32) JOINT USAEC-AECL MEETING ON PHYSICS OF HEAVY WATER MODERATED NATURAL URANIUM POWER REACTORS, APRIL 27-28, 1960. N. P. Baumann, ed. Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C. 69p. OTS.

A joint AEC-AECL meeting on the physics of D_2O-moderated natural uranium power reactors was held at Savannah River on Apr. 27 and 28, 1960. The restriction to natural uranium fuel was broadened to include slightly enriched uranium and mixed loadings of plutonium and uranium. Abstracts of the papers were prepared from notes taken at the meeting and from tape recordings of the individual talks. All tables and slides are included. (W.D.M.)

3681 (TID-6318(Vols. I and II)) TECHNICAL INFORMATION AND FINAL HAZARDS SUMMARY REPORT. PART B, LICENSE APPLICATION AEC DOCKET NO. 50-29. Yankee Atomic Electric Co., Boston. 1960. (Vol. I, 386p.; Vol. II, 537p.). OTS.

These two volumes were issued separately, but are cataloged as a unit.

The Yankee Pressurized Water Reactor is rated to produce 485 Mw of heat and 136 Mw of net electrical generation. The initial core, however, will produce approximately 110 Mw(e). Reactor design, plant design, site, accidents and hazards, and plant operation are discussed in detail. (W.D.M.)

3682 (TID-6761) THE ARMY NUCLEAR POWER PROGRAM: ITS REACTORS, AND THEIR APPLICATION TO THE LESS-DEVELOPED AREAS OF THE WORLD. Division of Reactor Development, AEC. 1960. 22p. OTS.

Presented before the International Atomic Energy Agency Conference on Small and Medium Power Reactors, Vienna, September 5-9, 1960.

The position of the USAEC regarding the development of small and medium land-based nuclear power plants with the Army Nuclear Power Program (ANPP) is explained, and it is shown how military activities in this field are integrated with those of the over-all reactor development program. The ANPP charter, mission, organization, and objectives are reviewed, and the reactor plants which make up the program are described. The economics involved in developing, constructing, and operating such plants is discussed. (W.D.M.)

3683 (TID-8518(Bk.8)) CIVILIAN POWER REACTOR PROGRAM. PART III. STATUS REPORT ON GAS-COOLED REACTORS AS OF 1959. Book 8. Atomic Energy Commission, Washington, D. C. 1960. 87p. GPO.

The technology of natural-uranium-fueled graphite-moderated gas-cooled reactor power plants is summarized for its relevance to the technology of enriched-fuel graphite-moderated systems. The technology of D_2O-moderated gas-cooled reactors is also summarized. Estimated technical performance parameters are given for the enriched-fuel prototype and for a large natural-uranium-fueled plant. Current technical status is discussed in terms of reactor physics, heat transfer and fluid flow, core materials, components, plant design and construction, and hazards. Detailed tables of characteristics for various reactors are given. An extensive bibliography is included. (W.D.M.)

3684 (WAPD-T-1158) TRANSFER FUNCTIONS FOR BOILING REACTOR STABILITY CALCULATION. S. G. Margolis and S. Kaplan. Westinghouse Electric Corp. Bettis Plant, Pittsburgh. Apr. 1960. 48p. Contract AT-11-1-GEN-14. OTS.

Lightly damped core power oscillations with a frequency characterized by the reciprocal of the core transport time have been observed in boiling reactors. The oscillations are attributed to regenerative feedback through the "inner" reactivity feedback loop in which the feedback path consists of heat generation in the fuel, heat transfer to the

coolant, and reduction of coolant density by steam voids. The voids drive the power and thus close the inner loop. A simplified analytical model for investigating the stability of the reactivity feedback loop in a boiling reactor is proposed. (W.D.M.)

3685 (NP-tr-490) NUCLEAR POWER PLANTS. (YADERNYYE ENERGETICHESKIYE USTANOVKI). P. A. Petrov. Translated from a Publication of the State Publishing House of Power Engineering, Moscow-Leningrad, 1958. 334p. OTS.

This volume embodies a course given by the author at the Moscow Power-Engineering Institute during 1956 to 1957. The volume gives the fundamental physical and thermal computations for thermal-neutron reactors, and the design of a nuclear power plant. A number of plants are described. (W.L.H.)

3686 AN APPROXIMATE CALCULATION OF THE BEST THERMODYNAMIC CYCLE FOR A NUCLEAR POWER STATION. Yu. D. Arsen'ev and E. K. Averin. Atomnaya Energ. 9, 133-4(1960) Aug. (In Russian)

Approximate formulas are suggested for the heat parameters and certain capital investment which influence the selection of thermodynamic cycles. (R.V.J.)

3687 CONTROL PROBLEMS IN THE OPERATION OF POWER REACTORS. H. Braun (Institutt for Atomenergi, Halden, Norway). Atomwirtschaft 5, 434-7(1960) Oct. (In German)

Operational safety is stressed in the control of power reactors. A brief survey is given of the methods used for power-reactor control. Analog computers for automatic operation are being developed, and future possible developments in this area are surveyed. (J.S.R.)

3688 RUNAWAY AND EMERGENCY SHUTDOWN AS TECHNICAL SAFETY PROBLEMS IN NUCLEAR POWER PLANTS. L. Merz (Siemens & Halske A. G., Karlsruhe, Ger. and Technische Hochschule, Karlsruhe, Ger.). Atomwirtschaft 5, 437-41(1960) Oct. (In German)

Runaway and emergency shutdown of power reactors are serious operational incidents even though no actual accident occurs. It is essential, by means of adequate instrumentation to achieve an accurate measurement of the reactivity variation, of the velocity of the control and shim rods, and of the excess multiplication constant. In this way unnecessary fast shutdown may be avoided. (auth)

3689 THERMODYNAMIC VIEWPOINT IN SHIP REACTORS. (ENGINEERING PROBLEMS IN SHIP REACTORS. II.). A. Mareske (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg). Kerntechnik 2, 283-4(1960) Sept. (In German)

In the second part of the article on the thermodynamic behavior of ship reactors (for Part I, see Kerntechnik 2, 244(1960)) the maximum heat output, heat transfer in heterogeneous reactors, and limits for the power output of a reactor are discussed. (J.S.R.)

3690 RADIOISOTOPE PRODUCTION IN POWER REACTORS. FEASIBILITY AND ECONOMIC STUDY. Nuclear Energy, 437-8(1960) Sept.

It was found that the cost of radioisotopes could be greatly reduced by producing them in power reactors. The isotopes studied were Co^{60}, C^{14}, H^3, P^{32}, Na^{24}, and K^{42}. To produce the relatively short-lived isotopes, rabbit tubes placed at the fringe cores could be used to produce quantities many times greater than those currently in demand. By making use of only the best locations the Dresden reactor alone would be capable of producing more than the estimated 1959 market for all six isotopes. It is estimated that Co^{60} produced in this manner would cost $0.379 per curie compared to the current price of $3.105. Other isotope prices are also estimated, considerably lower. Listings of these estimated prices are included. (M.C.G.)

3691 THERMOELECTRIC DIRECT CONVERSION IN NUCLEAR REACTORS. W. E. Shoupp (Westinghouse Electric Corp., Pittsburgh). Nuclear Energy, 458-61(1960) Oct.

The possible use of thermoelectric junctions in reactors for power generation is discussed. Since the materials usable at high temperatures usually have poor ductile and tensile characteristics, e.g., ceramics, a passive type of power generation such as the thermoelectric type is advantageous. The temperature drops in a water-cooled reactor fueled with UO_2 pellets enclosed in stainless steel or zirconium tubes are treated in some detail. The research program of Westinghouse in this field is briefly described. It is believed that the direct type (in which the thermoelectric elements are wrapped around the fuel elements) will be superior to the indirect type (in which hot coolant heats the hot junctions) for generators above 10 kw in size. Thermoelectric characteristic vs. temperature curves are presented for two groups of materials suitable for use as hot and cold junctions, respectively. Other passive types of power generation (thermionic and magnetohydrodynamic) are discussed briefly. (D.L.C.)

3692 INTEGRAL EXPERIMENTS FOR POWER REACTOR DESIGN. TYPES OF EXPERIMENTS TO BE CARRIED OUT IN NESTOR. G. W. K. Ford (Atomic Energy Establishment, Winfrith, Eng.). Nuclear Eng. 5, 513-16(1960) Nov.

The neutron source reactor NESTOR is to be utilized in performing experimental investigations in power reactor designs. Experiments are described that refer primarily to uranium-graphite and to water-moderated reactors, but there is no limit to the variety of types that may be studied with the possible exceptions of fast reactors or very small thermal reactors. (B.O.G.)

3693 BERKELEY — CONSTRUCTION AND DESIGN CHANGES. J. R. M. Southwood (Nuclear Power Group, [Knutsford, Ches., Eng.]), E. L. Haste, W. L. Partridge, R. Derrick, and R. W. Day. Nuclear Power 5, No. 55, 74-6(1960) Nov.

New graphite data and increased safety standards caused construction and design changes to be made in the Berkeley reactor. A theoretical study made on the reactor core indicated that some instability and power surging between sectors of the core might result from the xenon build-up. A further study resulted in changing the control rods from moving in unison to segregated movement. Individual control loops were installed in the core so that any local fluctuation would be detected and corrected by control-rod movement without causing any general power disturbances. The increased safety standards concerning the reduced permissible radiation level in buildings around the reactor called for more shielding than was in the original design. This change came into effect after most of the shielding was in place, and, as a result, much modification work on the site had to be done. Fortunately the increased wall thickness did not seriously affect the plant layout. A site plan is given for the reactors. The site staff and organization are discussed. The program control for the construction is outlined. The inspection procedures prescribed by Lloyd's for the reactor components are described. (B.O.G.)

3694 BRADWELL—CONSTRUCTION AND DESIGN CHANGES. R. D. Vaughan (Nuclear Power Group, [Knutsford, Ches., Eng.]), A. Young, and E. Anderson. Nuclear Power 5, No. 55, 77-9(1960) Nov.

A description is given of the changes in the design of the Bradwell reactor which resulted in alterations in the construction. Some changes were made in the graphite construction, control system, and safety standards. Throughout the construction constant attention was devoted to ways of ensuring against disastrous incidents to the neighborhood or the reactor. A description is given of the site staff and the construction organization for the housing of the workmen, fabrication of the pressure vessel, and the general services provided by the contractors. The form of the organization which successfully fulfilled the requirements of the original conception for handling the Bradwell contract is outlined. (B.O.G.)

3695 HUNTERSTON—CONSTRUCTION AND DESIGN CHANGES. A. N. H. Bond and D. W. T. Angwin (General Electric Co., Ltd., [Hunterston, Ayrshire, Scotland]). Nuclear Power 5, No. 55, 80-2(1960) Nov.

Experience in operating nuclear power stations and knowledge gained from research have resulted in modifications to the original design of the Hunterston power station. Many of the changes were in the design details and were easily accommodated. Others were more fundamental and have involved more important changes in mechanical, electrical, and structural aspects. Changes of design were made in the graphite column, cooling pond, graphite sleeve disposal, pressure-vessel and reactor-core support members, main gas circuit, and control and instrumentation. The management organization in charge of reactor construction is outlined according to staff and service departments. Descriptions are given of the site arrangements, planning and progress, and inspection and supervision. (B.O.G.)

3696 HINKLEY POINT—CONSTRUCTION. W. Wadkin and D. F. Hutton (English Electric Co., Ltd., [London]; Babcock and Wilcox Ltd., London; and Taylor Woodrow Construction Ltd., [London]). Nuclear Power 5, No. 55, 83-5(1960) Nov.

Instructions to proceed with construction were received in Sept. 1957; full access to the site was obtained in Dec. 1957, and work has since progressed steadily. The construction program is described. The construction includes reactor foundations, biological shield, turbine house, and circulating-water system. The welding inspection and erection of the reactor pressure vessel are described. The major problems encountered with the steam-raising units were similar to those for the pressure vessel but were less severe. Concurrent with work or the site, off-site activities are aimed at completing the substantial equipment program to achieve station operation in 1962. (B.O.G.)

3697 TRAWSFYNYDD—CONSTRUCTION. J. N. Bishop (Atomic Power Constructions Ltd., [London]). Nuclear Power 5, No. 55, 86-8(1960) Nov.

The contract was awarded in June 1959, and entry to the site was made on July 1, 1959. A program is shown which gives the outline of the construction work at the site. A description is given of the site, circulating-water system, and the site workshops. Because of the limited access to the site, the workshops are of a higher standard than those of other power stations. The problems encountered in bringing in the heavier components to the site are discussed. To ensure that items of the power plant are delivered to the site at the correct time, a team was organized to coordinate the efforts of the subcontractors and to expedite the work in the factories. (B.O.G.)

3698 ELASTICITY OR PLASTICITY OF AN AUSTENITIC CHROMIUM–NICKEL STEEL. Kurt Salmutter and Ferdinand Stangler (Universität, Vienna). Z. Metallk. 51, 544-8(1960) Sept. (In German)

Some tests were carried out on the elastic and plastic deformation of single crystals of an austenitic steel with 12% Cr and 12% Ni. The elastic parameters were determined from the modulus of elasticity and the modulus of rigidity. The elastic anisotropy of the γ iron is essentially larger than that of α iron. (auth)

3699 THE STABILITY AND CONTROL OF NUCLEAR ROCKET ENGINES. A. H. Stenning (Massachusetts Inst. of Tech., Cambridge and Pratt and Whitney Aircraft, East Hartford, Conn.) and H. P. Smith. Paper No. 1239-60. Presented at the ARS Semi-Annual Meeting, Los Angeles, California, May 9-12, 1960. New York, American Rocket Society, 1960. 28p.

The dynamics and stability of a nuclear rocket engine with a bleed turbine pump drive were studied with the aid of an analog computer. The open loop stability of the system depends only on the sign of the temperature coefficient of reactivity of the empty reactor and is independent of the propellant density coefficient of reactivity. Rapid controlled starts were simulated with a pressure controller on the turbine valve and a temperature controller on the reactor control rods. (auth)

3700 THE SNAP 2 CONCEPT. H. M. Dieckamp (Atomics International, Canoga Park, Calif.). Paper No. 1324-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 11p.

The objectives of the SNAP 2 program are to develop, test, and qualify a 3 Kwe nuclear auxiliary power unit for space utilization prior to 1964. The over-all SNAP 2 development effort is directed toward these general objectives: minimum weight, maximum reliability, operational safety, producibility, mission environment compatibility, and minimum payload design restrictions. The results of preliminary design studies that evaluated the state of the art of reactor and power conversion technology, as well as projected space vehicle and mission requirements, have established the following specific development objectives for SNAP 2: 3 Kwe net output, one-year unattended automatic operation, system weight less than 750 lb, and cycle heat rejection area less than 110 ft^2. In order to meet these objectives, the SNAP 2 reactor employs a homogeneous fuel moderator of zirconium hydride containing 10 wt. % U^{235}. For minimum weight, the reactor is reflected by beryllium and controlled by variations of the effective reflector thickness. The SNAP 2 system employs a mercury Rankine cycle for power conversion. (auth)

3701 PROBLEMS ASSOCIATED WITH THE DEVELOPMENT OF A THERMIONIC CONVERSION REACTOR. R. L. Hirsch and J. W. Holland (Atomics International, Canoga Park, Calif.). Paper No. 1338-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 12p.

A conceptual design of a 300 kw(e) thermionic space power reactor is described with a subsequent discussion of associated development requirements. The thermionic converter is integrated into the nuclear reactor core in

such a manner that the fuel material also serves as the cathode of the converter. The thermionic fuel elements are assembled into a close spaced hexagonal lattice to form a 9-in. in diameter by 10-in.-long cylindrical reactor core. Assumptions of converter performance are based on a reasonable extrapolation of current experimental data. The requirements that exist for all materials within the thermionic cells include high temperature capability, physical and chemical compatibility, fabricability and joinability, and ability to withstand thermal cycling and a high radiation environment. The techniques for increasing core performance by thermionic converters are discussed. (M.C.G.)

3702 NUCLEAR REACTOR-THERMIONIC SPACE POWER SYSTEMS. L. W. Perry (General Atomic, Div. of General Dynamics Corp., San Diego, Calif.). Paper No. 1339-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 8p.

Thermionic power conversion was applied to space power systems by locating cells internal and external to the reactor. The cells may be wrapped about the outer surface of the reactor core or placed inside the reactor, a liquid metal coolant being used to transfer waste heat to an external radiator. The serious limitation to exterior cells is the limited growth potential to higher power levels. When thermionic cells were incorporated in a reactor, an over-all system efficiency of 12% was obtained. Liquid lithium was used as a reactor coolant. If sufficient cathode life can be obtained, a space power system with a specific weight of 5 to 6 lb/kw(e) at the 300 kw(e) power level is possible. (M.C.G.)

Research Reactors

3703 (ANL-6174) THE REACTOR KINETICS OF THE TRANSIENT REACTOR TEST FACILITY (TREAT). D. Okrent, C. E. Dickerman, J. Gasidlo, D. M. O'Shea, and D. F. Schoeberle. Argonne National Lab., Ill. Sept. 1960. 65p. Contract W-31-109-eng-38. OTS.

A description of the TREAT facility is presented. The static characteristics of the reactor which pertain to its dynamic behavior, such as temperature coefficient and prompt-neutron lifetime, are discussed. Also considered are other phenomena, the analyses of which provide some measure of the general adequacy of the calculational techniques employed. The correlation and analysis of transient-experiment results on this clean-geometry reactor are examined in considerable detail. In addition, an extrapolation of the reactor's performance beyond the present low design limitation of 400°C maximum local temperature is included. (auth)

3704 (CEA-1593) ÉTALONNAGE EN PUISSANCE DE PROSERPINE. (Power Calibration of Proserpine). C. Clouet d'Orval, E. Deilgat, M. Guery, and J. Tachon. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. Dec. 1959. 32p.

The power of a homogeneous reactor can be determined if the fission rate at one point is known, and the flux chart throughout the whole volume of fuel can also be established. By applying this method to Proserpine, the following operations have been carried out: determination of the fission rate at a point by means of a minature zirconium fission chamber, with absolute counting of the plutonium deposit in a low-geometry α chamber, and establishment of a flux chart by activation of gold bands, without contamination of gold by plutonium. (auth)

3705 (CEA-1595) MESURE DU TEMPS DE VIE DANS PROSERPINE PAR MODULATION DE LA RÉACTIVITÉ. (Lifetime Measurement in Proserpine by Reactivity Modulation). C. Clouet d'Orval, J. Tachon, J. Bertrand, and P. Lecoustey. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. Feb. 1960. 16p.

The measurement method consists in varying the neutron flux periodically by means of an oscillator with cadmium sectors. From the signal received on a detector the lifetime τ can be determined; for various velocities ω, $(n/\delta n)^2 = (Beff/\delta k)^2 + (\tau/\delta k)^2 \omega^2$. Various corrections are involved, in particular the calculation of the rates of different harmonics in the oscillator signal. (auth)

3706 (IDO-16538) THERMAL NEUTRON FLUX MEASUREMENTS AT THE MTR-ETR SITE. C. H. Hogg. Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho. Oct. 28, 1960. 43p. Contract AT(10-1)-205. OTS.

The methods for measuring thermal-neutron fluxes at the MTR-ETR site, as well as the use of standard gold and indium foils and cobalt wire as flux monitors, are discussed. The errors involved in the flux measurements are estimated. (auth)

3707 (LAMS-2469) QUARTERLY STATUS REPORT ON TURRET REACTOR EXPERIMENT FOR PERIOD ENDING AUGUST 20, 1960. Los Alamos Scientific Lab., N. Mex. Sept. 1960. 70p. Contract W-7405-eng-36. OTS.

The Turret reactor program will study the practical effects on both the reactor and the coolant system of using porous, unclad fuel elements. In pursuit of this fundamental objective, efforts will be directed toward detailed study of the following points: (1) the behavior of unclad, porous graphite fuel elements at high temperatures under operating reactor conditions with respect to release of fission products and with respect to the degree of burn-up of uranium which may be practicably achieved in fuel elements of this general nature; (2) the operation of a high-temperature coolant loop highly contaminated with fission products (specifically, the nature of the fission products deposited, mechanisms of deposition, and effects of various types of surfaces and flow parameters, as well as maintenance techniques and applicable methods of fission product removal); (3) the basic requirements and effectiveness of gas-coolant purification systems for closed-cycle contaminated gas loops of this nature; and (4) the degree to which low-cost, chemically and mechanically simple fuel-reprocessing methods may be applied to fuel elements of this general character. Developments are summarized on the reactor, coolant system, gas-cleanup system, reactor facility, and materials. (W.D.M.)

3708 (NDA-2131-9) PAWLING LATTICE TEST RIG OPERATING MANUAL. R. Schamberger and C. Foster. Nuclear Development Corp. of America, White Plains, N. Y. Apr. 21, 1960. 62p. Contract AT(30-1)-2303(IX). OTS.

The Pawling Lattice Test Rig (PLATR) is a D_2O-moderated, graphite and masonite-reflected critical system with a multiregion core. It is constructed in a 5 × 5 ft aluminum tank with a sectional aluminum and masonite cover. The PLATR is to be used to measure the infinite multiplication factor and a variety of lattice parameters of natural uranium lattices through the use of only a small sample of the lattice placed in the center of an enriched reactor. The general procedures presented in NDA-2-74 (Operating Manual for the NDA Pawling Critical Facility) are supplemented and extended. (W.D.M.)

3709 (NP-9388) HAZARDS SUMMARY REPORT FOR THE DEFENSE ATOMIC SUPPORT AGENCY BIOMEDICAL RADIATION RESEARCH FACILITY. ADDENDUM I. National Naval Medical Center, Bethesda, Md. Sept. 20, 1960. 96p. OTS.

The Biomedical Radiation Research Facility is being built for the Defense Atomic Support Agency. An essentially identical prototype reactor to the reactor proposed for the government facility was designed, built, and tested. This reactor was called the TRIGA Mark F reactor. Buildings and associated facilities are described. A summary of TRIGA Mark F test results is presented. Calculations are included of maximum fission product release after a fuel-element failure and predicted reactor reactivity and associated hazards. (C.H.)

3710 (TID-7588(p.36-55)) FLUX MEASUREMENTS AND IRRADIATION ASSEMBLIES USED IN THE LITR, MTR, AND ORR REACTORS. J. C. Zukas and R. G. Berggren. Oak Ridge National Lab., Tenn.

Neutron flux measurements are necessary in any attempt to explain the results of irradiation tests, as well as to correlate the results obtained from tests operated in different reactor facilities. The spatial distribution of neutron flux was monitored in the horizontal beamhole No. 3 of both the Low Intensity Test Reactor and the Materials Testing Reactor, in the F-1 and C-8 core positions, and in the poolside facility of the Oak Ridge Research Reactor. Problems of conducting experiments in nuclear reactors are discussed briefly. (W.D.M.)

3711 NUCLEAR CALCULATION OF HIGHLY-ENRICHED WATER-MODERATED REACTORS. [PART] II. H. Grümm and F. Putz (S. G. P. und Technische Büro der Reaktor-I. G., Vienna). Atomkernenergie 5, 371-9 (1960) Oct. (In German)

The use of equations derived in the first part for the calculation of swimming pool reactors is illustrated by a calculation of a 5- by 4-element core configuration for the ASTRA reactor. The calculated results are compared with experimental results. The programming of the IBM-650 for the calculations is given. (J.S.R.)

3712 THE POSSIBILITY OF POST-IRRADIATION EXAMINATION ASSOCIATED WITH THE BR-2 REACTOR. PART II. J. Planquart (Centre d'Études Nucléaires, Saclay, France). Bull. inform. assoc. belge develop. pacifique énergie atomique No. 28, 3-4(1960) Sept. (In French)

This second part of the description of postirradiation examination facilities is devoted to hot cells. The term "hot cell" is first defined, and then the disassembly and observation cells are described in some detail. Characteristics of cells and the particular characteristics of those at the BR-2 Reactor are discussed. (J.S.R.)

3713 SOME EFFECTS OF IONIZING RADIATIONS ON GELATIN. Richard I. Mateles and Samuel A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Food Technol. 12, 633(1958).

Investigation of the effects of ionizing radiations on the intrinsic viscosity and gel strength of gelatin indicated that radioinduced cross-linking of polymer chains is relatively small compared to the degree of fracturing of peptide links within individual molecules. The degree of splitting of the gelatin molecules was insufficient to cause any reduction in gel strength. (M.C.G.)

3714 CANADA-INDIA REACTOR. N. B. Prasad (Atomic Energy Establishment, Trombay, India). J. Sci. Ind. Research (India) 19A, 407-10(1960) Sept. (In English)

The Canada-India Reactor is a natural-uranium-fueled heavy-water-moderated light-water-cooled reactor with a power of 40 Mw. The reactor is housed in a pressure shell of steel, 120 ft in diameter and 134 ft high. The reactor vessel is an aluminum tank 8 ft 9 in. in diameter and 11 ft high. Two cast iron thermal shields are placed around a graphite reflector. These are surrounded by an 8-ft-thick biological shield. Above the reactor vessel are one aluminum and two steel thermal shields and four concrete biological shields, each 1 ft thick. The heat removed by the primary cooling water, heavy water, and thermal shield cooling water is transferred to sea water in heat exchangers. Boron carbide is used for the control rods. The associated buildings and auxiliary facilities are briefly described. (M.C.G.)

3715 IRRADIATION PROCEDURES AT THE FRM. M. Pollermann and W. Marth (Technische Hochschule, Munich). Kerntechnik 2, 265-7(1960) Sept. (In German)

A survey is made of the irradiation procedures at the Munich Research Reactor for both low and high doses. The methods discussed include the fishline procedure, the pneumatic tube procedure, and the hot cell procedure. (J.S.R.)

3716 THE DEVICES FOR THE CONTROL OF THE RADIOACTIVITY OF THE LIQUID AND GASEOUS EFFLUENTS OF THE ISPRA-1 REACTOR AND ANNEXES. A. Benco, C. Dominici, P. Gaglione, and A. Malvicini (Centro di Studi Nucleari, Ispra, Italy). Minerva nucleare 4, 271-7(1960) Oct. (In Italian)

The devices for the control of radioactive contamination of gaseous and liquid effluents of the Ispra-1 reactor are described. The monitors for radioactive gases are NaI(Tl) crystal scintillation counters with a sensitivity of 10^{-5} $\mu c/cm^3$. The monitors for airborne particulate radioactivity are fixed filter monitors with a sensitivity of 10^{-10} $\mu c/cm^3$. The continuous monitors for radioactivity in liquids are thin end-window Geiger-Mueller counters with a sensitivity of 10^{-5} $\mu c/ml$. All the monitors were designed and manufactured in the Ispra Nuclear Studies Center. (auth)

3717 CONTAINMENT VESSELS FOR REACTORS BR II AND BR III AT MOL. G. Herzet, P. Laval, and G. Martelée (Cockerill-Ougrée, S. A., Brussels). Nuclear Energy, 403-7; 420(1960) Sept.

The essential characteristics of the BR II and BR III reactors being built at Mol, in Campine, are given in a discussion of the containment vessel design. The BR II pressure vessel has a cylindrical body with a flat base and torispherical dome. A reinforced concrete wall about 2 ft thick runs around the interior of the cylindrical body. A 1 in. layer of insulating material separates it from the steel wall. Most of the openings were devised in such a way that they can be submitted to air pressure tests to check their airtightness separately and independently of the pressure vessel. The BR III pressure vessel is cylindrical in shape with a spherical dome and torispherical base. An internal concrete shield was also used in this vessel. The choice of steel depended chiefly on weldability, and Soudstenax 41 steel was chosen for this reason for both containment vessels. (M.C.G.)

3718 CONTAINMENT VESSELS FOR BELGIAN REACTORS BR II AND BR III. PART II. G. Herzet, P. Laval, and G. Martelée (Cockerill-Ougrée, S. A., Brussels). Nuclear Energy, 468-70; 73(1960) Oct.

The design calculations and final dimensions of the pressure vessels for the BR-2 and BR-3 reactors are

given. The effects of internal depression and wind are allowed for. Silicon rubber was chosen for the airtight joints of the air locks and other inlets in the BR-2. The stresses in the pressure vessels were studied with a scale model, and local bending was observed. A large air lock was constructed in the BR-2 for heavy vehicles in addition to personnel air locks, and the screwjacks used in the air lock are discussed. The fuel transfer tank of the BR-2 is described briefly. (D.L.C.)

3719 THE DESIGN OF NESTOR. J. R. Griffin (Atomic Energy Establishment, Winfrith, Eng.). Nuclear Eng. 5, 506-8(1960) Nov.

The NESTOR, a modified Jason reactor, has an MTR type core forming an annulus, water being both moderator and coolant; cooling is by natural convection between the plates. This neutron source reactor is approximately 5 ft square in plan and is surrounded by four demountable caves measuring 8 × 8 × 7.5 ft inside with sliding doors to close the entrances. To satisfy the high utilization envisaged, it was necessary to modify Jason to meet the requirement of continuous running at a power level of 10-kw. The majority of the modifications were necessary to meet high availability and to accomodate new shield design. The original Jason control mechanisms were modified to reduce induced activation and radiation damage. The designs incorporated in the shielding and experimental facilities are discussed. The modifications were made so as to make the NESTOR capable of driving four subcritical assemblies in the caves constructed against each of the four vertical faces and one liquid-moderated assembly overhead. (B.O.G.)

3720 THE AUTOMATIC POWER LEVEL CHANGING AND THE AUTOMATIC COMPENSATION OF THE REACTIVITY CHANGES IN THE WWR-S REACTOR. P. Szulc (Inst. for Nuclear Research, Warsaw). Nukleonika 5, 503-12(1960). (In Russian)

The principle of operation and constructional design of the improvements in the control instrumentation of the WWR-S (EWA) reactor are described. Using a moveable neutron detector, the circuit for reactor level changing with constant doubling time of the reactor was developed. The circuit for automatic compensation of the slow changes of the reactivity, and improvements in the safety instruments of the reactor power level changing were also developed. (auth)

3721 FIRST CIRCUIT WWR-S REACTOR IN POLAND WATER ANALYSIS. Z. Bieguszewski, K. Żarnowiecki, and A. Kostyrko (Inst. of Nuclear Research, Warsaw). Nukleonika 5, 541-50(1960). (In Russian)

The prooiems of water purity in the primary circuit of the WWR-S Reactor in Poland are described. For water purification, ion and mechanical filters were used. The water analysis during the two years exploitation period showed that there was no serious corrosion in constructive materials of primary reactor circuit. (auth)

3722 THE JANUS REACTOR INSTRUMENTATION. Donald C. Thompson (Argonne National Lab., Ill.). Preprint No. 35-NY60. Presented at Fall Instrument-Automation Conference and Exhibit, New York City, September 26-30, 1960. Pittsburgh, Instrument Society of America, 1960. 4p.

JANUS is a specially designed reactor being built at Argonne National Laboratory to determine the effect of neutrons on biological specimens and to be used for other biological research. The nuclear and process instrumentation is described together with the unusual features of the instrumentation system. (auth)

WASTE DISPOSAL AND PROCESSING

3723 (CEA-1433) UNE SOLUTION DE STOCKAGE DANS LE SOL DES BOUES RADIOACTIVES DE MARCOULE. (A Project for Storing the Radioactive Sludges from Marcoule in the Soil). P. Cohen and C. Gailledreau, France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay. 1960. 35p.

A study was made of the feasibility of storing radioactive sludges in the soil. Special attention is paid to the case of the Marcoule plant, which produces three kinds of sludges. The movement of the different fission products was investigated. (auth)

3724 (CEA-1435) STOCKAGE ET EVACUATION DES DECHETS RADIOACTIFS SOLIDES. (Storing and Disposal of Solid Radioactive Waste). J. Pomarola. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 25p.

Conference held in Monaco, November 1959.

The plans under consideration for the final destination of solid radioactive wastes are presented. It is first of all necessary to provide in each center an organized temporary storage dump. Several types of temporary dumps are suitable and can coexist in the same area: on the ground, in buildings, or in basements. To accomplish a definitive storage arrangement it is necessary, as a function of the activity and the conditioning of the wastes, to define the site and the means of transport considered both inside and outside nuclear centers. The solution adopted depends on the above factors, and plans for definitive storage on the ground, under ground, and in the sea are examined successively. Economic considerations play a large part in the decision reached. (auth)

3725 (CEA-1436) CONDITIONNEMENT DES DÉCHETS RADIOACTIFS SOLIDES. (Conditioning of Solid Radioactive Wastes). P. Cerre. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 11p.

Since solid radioactive wastes are of varied forms, dimensions, and volumes, the C. E. A. first reduces the volume by breaking up the compacting. Since these wastes cannot be temporarily stored without contamination risk, an effective packing process is used. This consists in burying the wastes in a specially planned concrete with high mechanical resistance, maximum insolubility, resistance to corrosion, maximum imperviousness, and providing protection against radiation. It is then possible to store the blocks safely, with a view to eventual definitive rejection. (auth)

3726 (CEA-1438) ELIMINATION PAR DILUTION D'EFFLUENTS LIQUIDES FAIBLEMENTS RADIOACTIFS LEURS CONSEQUENCES. (Elimination of Slightly Radioactive Liquid Effluent by Dilution. Its Consequences). P. Bovard and C. Candillon. France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay. 1960. 35p.

Nuclear centers often have to solve problems raised by the elimination of large volumes of slightly radioactive liquid effluent. As things stand at present, the method usually adopted consists in expelling this effluent into the

main water system in order to dilute it to a maximum and thus to lower its radioactive-isotope concentration to below the norms imposed by the Public Health Service. This technique requires systematic checking of the water system and its dependences and demands a thorough knowledge of adsorption and fixation processes. (auth)

3727 (HW-48862) DISPOSAL OF HIGH COBALT-60 SCAVENGED WASTES. W. A. Haney. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Mar. 4, 1957. 9p. Contract W-31-109-Eng-52. OTS.

A disposal plan is outlined for disposing TBP scavenged wastes which are high in Co^{60} into cribs. The plan is based on an expected in-farm scavenging rate of 700,000 gallons of supernate per month. (C.J.G.)

3728 (HW-50132) PROPOSED USE OF TEST WELLS TO BE INSTALLED AS PART OF THE HIGH COBALT-60 SCAVENGED WASTE DISPOSAL TESTS. W. A. Haney. General Electric Co. Hanford Atomic Products Operation, Richland, Wash. May 7, 1957. 6p. OTS.

The use of wells for sites of high Co^{60} scavenged waste disposal is discussed. Monitoring requirements are discussed. (C.J.G.)

3729 (IDO-14529) DETERMINATION OF TOTAL FISSION PRODUCT MOLYBDENUM, TECHNETIUM, AND TELLURIUM IN ICPP WASTE TANKS. William J. Maeck, Fred W. Dykes, and Stanley S. Yamamura. Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho. Sept. 13, 1960. 24p. Contract AT(10-1)-205. OTS.

Analytical methods are described for the determination of total fission-product molybdenum, technetium, and tellurium in Idaho Chemical Processing Plant waste tanks. Molybdenum was determined by a cation exchange method. Technetium was determined by a preliminary anion-exchange separation followed by a spectrophotometric technique. A spectrophotometric method employing diethyldithiocarbamate was used to determine tellurium. (C.J.G.)

3730 (IDO-14533) STAINLESS STEEL PROCESS WASTES: I. REMOVAL OF ALLOY METALS FROM WASTE SOLUTIONS BY MERCURY CATHODE ELECTROLYSIS. M. E. McLain and D. W. Rhodes. Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho. Sept. 19, 1960. 12p. Contract AT(10-1)-205. OTS.

A method is proposed for the separation of the metal ions iron, nickel, and chromium from the fission products in wastes resulting from the chemical processing to recover uranium from reactor fuels clad or alloyed with stainless steel. A separation of the alloy metals and the fission products was accomplished in the laboratory by electrolysis of the alloy metals over a mercury cathode. The standard reduction potentials at the mercury cathode of the major long-lived fission products are such that they are difficult to reduce electrolytically in acid solution. The removal of alloy metal ions from solution by mercury cathode electrolysis permits the alloy constituents and the fission products to be treated as separate wastes. The alloy constituents may be converted to a solid and stored in low integrity containers without danger of self-heating from fission product decay. The fission product waste can be reduced to a very small volume for storage and recovery of valuable fission products or converted to a solid for permanent disposal. (auth)

3731 (NP-9351) DISPOSITION OF RADIOACTIVE MATERIAL IN THE OCEAN. Reviews and Lectures No. 59. C. L. Newcombe. Naval Radiological Defense Lab., San Francisco. June 30, 1958. 22p.

A review is presented of findings on problems created by artificial radioactivity in the sea. The fragmentary state of knowledge of natural processes in the ocean is emphasized, and specific areas where information is needed are pointed out. A brief summary of data on the amounts of radioactive wastes disposed of in the ocean is included. (T.R.H.)

3732 (USACRDL-TM-50-1) COLD WEATHER DECONTAMINATION STUDY. Joseph C. Maloney. Army Chemical Research and Development Labs., Army Chemical Center, Md. July 1960. 32p.

A study is described which was conducted to collate existing data pertinent to radiological decontamination under cold-weather conditions. Other aspects studied were the requirements for additional cold-weather-decontamination experimental data needed to provide input for a manual addendum, and requirements for a program to provide additional data in this field. (J.R.D.)

3733 (AEC-tr-4302) A STUDY OF RADIOACTIVE DECONTAMINATION: THE EFFECT OF CONDENSED PHOSPHATES ON THE RADIOACTIVE DECONTAMINATION OF VARIOUS METAL SURFACES. Yuzo Tazima and Yoshiki Wada. Translated from Nippon Kagaku Zasshi 81, 891-5 (1960). 20p. (Includes original, 5p.). JCL.

The effect of various condensed phosphate solutions on the radioactive decontamination of stainless steel, brass, iron, lead, copper, and aluminum surfaces contaminated with a $CoCl_2$ solution containing Co^{60} was investigated. Chelating agents were found to be effective as decontaminating agents. The relation between the pH and the tendency toward complex-ion formation of condensed phosphates with $Co^{60}Cl_2$ and the fission products was studied. (C.J.G.)

3734 USE OF TRITIUM FROM SPENT URANIUM FUEL ELEMENTS AS A GROUND-WATER TRACER. J. H. Horton and D. I. Ross (E. I. du Pont de Nemours and Co., Wilmington, Del.). Soil Sci. 90, 267-71(1960) Nov.

Results are presented of a study to determine the usefulness of the tritium present in liquid waste from the chemical separation of spent uranium fuel elements as an aid in tracing ground water near radioactive waste ground disposal areas. The seepage basins in routine use by a chemical separations area were studied between October 1958 and January 1959. The outcrop of seepage basin water in a nearby creek and the zone of most rapid movement of the water between basins and creek were determined. Results showed that the movement of ground water from the seepage basins was quite irregular. The study showed that tritium can be used successfully in tracing the movement of ground waters. (M.C.G.)

3735 INTERNATIONAL CONTROL OF NUCLEAR MARITIME ACTIVITIES. Lee M. Hydeman and William H. Berman. Ann Arbor, Mich., University of Michigan, 1960. 397p.

The problems of international control of nuclear maritime activities is treated in detail, particularly from the standpoint of health and safety control. The topics covered include transport and sea disposal of radioactive materials, nuclear-powered ships, access to ports and waters, and legal aspects. Recommendations are given for the development of intranational and international law on this subject. (D.L.C.)

3736 DISPOSAL OF RADIOACTIVE WASTES. CONFERENCE PROCEEDINGS, MONACO, 16-21 NOVEM-

BER 1959. VOL. 2. 1960. International Atomic Energy Agency, Vienna. 581p. $6.00.

The proceedings are divided into areas of discussion on biological aspects of disposal at sea; physical and chemical aspects of disposal at sea; advantages and disadvantages of disposal at sea; research required for safe disposal at sea; considerations on waste disposal to the ground; and advantages and disadvantages of disposal in geological structures. Included in the proceedings are abstracts of the individual papers in English, French, Russian, and Spanish. For the papers given in French and Russian, English translations are included. Separate abstracts have been prepared for 36 of the 38 papers included. Two papers were previously abstracted in NSA. (B.O.G.)

3737 BIOLOGICAL ASPECTS OF DISPOSAL OF RADIOACTIVE WASTES IN MARINE ENVIRONMENTS. Walter A. Chipman (United States Bureau of Commercial Fisheries). p.3-15 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Disposal of radioactive wastes in marine waters allows for an accumulation of radioactivity by marine life. Such an accumulation by seafood organisms might affect their utilization or availability. Laboratory studies of accumulation of important radionuclides present in different wastes by marine plankton, benthic invertebrates, and various species of marine fish, and of the biological effects of accumulated radioactivity on these forms are being conducted at Beaufort, North Carolina, as a cooperative activity of the U. S. Atomic Energy Commission and the U. S. Bureau of Commercial Fisheries. These investigations help provide essential information for the formulation of waste disposal practices and the safe operation of nuclear-powered ships in coastal waters. They are useful in the development of monitoring programs designed to detect and evaluate hazards from accidental pollution of inshore waters. (auth)

3738 FISHERIES RADIOBIOLOGY AND THE DISCHARGE OF RADIOACTIVE WASTES. F. Morgan (Fisheries Radiobiological Lab., [Lowestoft, Eng.]). p.17-24 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

In the United Kingdom authorizations to discharge radioactive wastes are granted by the Minister of Housing and Local Government, the Minister of Agriculture, Fisheries, and Food, and by the Secretary of State for Scotland. The hazards arising from contamination of aquatic animals and plants concern the Department of Fisheries; before authorizations to discharge liquid wastes were given, the Department made independent forecasts of permissible levels of discharge based on extensive studies carried out in its research vessels and radiobiological laboratory: for example, where fish were affected this meant studies of fish populations and fish migration; uptake of radioactivity by fish; public consumption of fish; commercial distribution of affected fish; LD_{50}; effects of radiation on tissue, etc. In the course of the work there was close consultation with the Atomic Energy Authority, and agreement on the safety factor to be incorporated during the first two years of discharge. During these two years, monitoring data collected by the Atomic Energy Authority and the Ministry of Agriculture, Fisheries, and Food enable checks and revisions of the original estimates to be made, and at the end of that time formal authorizations, based on operating experience, are issued. (auth)

3739 ECOLOGY OF ACANTHARIA AND STRONTIUM CIRCULATION IN THE SEA. Bruno Schreiber (Univ of Parma, Italy). p.25-38 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

The biochemical cycle of strontium in sea water is considered and the proposed program and objectives are examined. The Acantharia group was selected for this study since it is the only one that has a specific and exclusive deposit of strontium. It is of particular interest in relation to the problems concerning the circulation of strontium and radioactive isotopes resulting from fall-out. (auth)

3740 THE CNRN RESEARCH PROGRAMME FOR THE STUDY OF RADIOISOTOPE ACCUMULATION BY MARINE ORGANISMS AND ITS EFFECTS AS REGARDS RADIOACTIVE CONTAMINATION OF THE OCEAN. A. A. Buzzati-Traverso and M. Bernhard (National Committee for Nuclear Research, Milan). p.39-42 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

A description is given of a research program undertaken by the Comitato Nazionale per le Ricerche Nucleari (CNRN) with a view to considering the whole complex ecological system of the sea in order to trace the paths of radioactive materials that may reach marine products for human consumption. The program began with an intensive study of a limited area representative of the Mediterranean and falls into two parts, descriptive analysis and experimental analysis. The area chosen, details of the laboratory and staff, and the general tasks to be carried out are described. Some preliminary results are given. (auth)

3741 PROBLEMS ARISING FROM DISPOSAL OF LOW-ACTIVITY RADIOACTIVE WASTE IN THE COASTAL WATERS OF THE NETHERLANDS. P. Korringa (Netherlands Inst. for Fishery Investigations, IJmuiden). p.51-6 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Low-activity waste discharged in coastal waters will find its way into the marine food chain in two entirely different ways: Adsorption to the surface of plankton organisms and adsorption to silt particles. In the latter case, fish and other creatures may ingest the loaded particles with their regular food. If the elements under consideration are not of primary biological importance to the organisms concerned, accumulation will not increase geometrically. Much of the radioactive material attached to ingested silt particles will leave the organisms later. Accumulation through active uptake of elements collected in dissolved state by shell-bearing organisms. Copper, zinc, manganese, cobalt, and the like are accumulated very strongly by shell-forming creatures like mollusks, and are stored in the connective tissues. If a part worth mentioning of these elements is of a radioactive nature, accumulation could attain alarming levels. Shrimps, Dover soles, plaice, and mussels being the main fishery products in the vicinity of the pipeline planned for the Netherlands center for reactor research, noticeable accumulation of radioactive waste in these organisms should be prevented. The special international position of the Netherlands fish market requires extra care, and migration of fishes and shrimps makes it impossible to avoid a contaminated area. (auth)

3742 CONTAINMENT OF RADIOACTIVE WASTE FOR SEA DISPOSAL AND FISHERIES OFF THE CANADIAN PACIFIC COAST. Michael Waldichuk (Fisheries Research Board of Canada, Biological Station, Nanaimo,

B. C.). p.57-77 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Low-level radioactive waste consists largely of contaminated laboratory trash, larger items of equipment, animal carcasses from biological tracer experiments, active liquids, and some reactor-irradiated materials. A total of 16,288 55-gallon drums of low-level waste was dumped off the coast of California from 1946 to 1957, inclusive. The major objectives of the criteria for U. S. sea disposal operations are safety in handling between waste originator and disposal site, and adequate sinking of wastes in the sea. There has been no requirement for integrity of container or contents at depth. Other techniques used or previously suggested for radioactive waste containment, such as canning, adsorption on clay, and integration into glass are described. In order to render a radioactive waste harmless to fish and other aquatic organisms, it must be either isolated from the environment or dispersed to levels of permissible concentrations. A spherical vault of suitable engineering design, hermetically sealed and able to withstand high pressures, is proposed for low-level and intermediate-level solid waste disposal, as a means of isolating the waste from the environment. Fish may be affected by radioactive waste in their environment through (1) direct radiation from the disposed radioactive material; (2) ingestion of food organisms containing concentrated radioisotopes; (3) irradiation by water containing radioactive ions or particles; and (4) contamination by bottom materials rich in precipitated radioisotopes. Research necessary before widespread marine disposal of radioactive waste should be permitted is suggested. (auth)

3743 ON MIXING PROCESSES IN THE SEA. Joachim Joseph (German Hydrographic Inst., Hamburg). p.79-91 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

A survey is given showing the present stage of theoretical knowledge and practical experience. Within certain limits statistics can shed light on the diffusion in sea water of a certain concentrated substance from one point over areas of medium radii of 10 to 1500 km. This method depends on facts connected with the turbulence spectrum, still unknown for many sea areas. Differing conditions in various areas of the ocean and in the marginal or mediterranean seas are explained. A plan is submitted for an intensification of the necessary oceanographic research work on an international basis. (auth)

3744 THE EFFECT OF FISSION PRODUCTS ON THE RADIOACTIVITY OF SOME HYDROBIONTS OF THE PACIFIC OCEAN. P. A. Moiseev and A. V. Kardashev (All-Union Marine Fisheries and Oceanographical Scientific Research Inst., Moscow). p.93-8 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In Russian and English)

The fact is emphasized that currents in water masses disperse radioactive elements over large distances, with the result that many marine fauna and flora far removed from the centers of contamination may accumulate dangerous concentrations of such elements. (auth)

3745 ADSORPTION AND BIOCIRCULATION IN OCEANIC WATERS. L. A. Zenkevich. p.99-103 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In Russian; English; French; and Spanish)

The form, degree, and extent of sea water contamination by fission products were investigated. It is evident that "biocirculation" cannot be left out as a means of transport or system of adsorption. The adsorption surface for various plankton groups in average density distribution zones, and the index of subsurface biocirculation in a water column $<1m^3$ in the habitat, are given. (B.O.G.)

3746 MARINE BIOLOGICAL INVESTIGATIONS AT THE ENIWETOK TEST SITE. Frank G. Lowman (Univ. of Washington, Seattle). p.105-38 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

The results of marine biological investigations conducted at the Eniwetok Test Site since 1952 are summarized. Radioisotopes introduced into the sea from the tests at various times since then include fission products and other radioisotopes (U^{237}, Np^{239}, Mn^{54}, $Fe^{55,59}$, $Co^{57,58,60}$, Zn^{65}, and W^{185}). The levels of radioisotopes in plankton samples taken 4 days to 6 weeks after contamination are reported and the distribution of the radioactivity between plankton and water is given. Grazing fishes contained Zn^{65}, Fe^{55}, $Co^{57,58,60}$, and Mn^{54}. Carnivorous fishes contained mostly Fe^{55} and Zn^{65}. (auth)

3747 DISPERSION OF CONTAMINANTS IN AN ESTUARINE PORT AREA. A. R. Gordon, Jr. (U. S. Navy Hydrographic Office, Washington, D. C.). p.151-61 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

An experiment is described wherein fluorescein dye was introduced into the James River Estuary, and its subsequent dispersion and dissolution was measured. Results are discussed in relation to the oceanography of the estuary and are compared with the dispersion predicted using various techniques described in literature. (auth)

3748 A METHOD OF COMPUTING THE SPREADING OF MATTER IN THE WATER OF AN ESTUARY. R. Dorrestein (Koninklijk Nederlands Meteorologisch Instituut, de Bildt). p.163-6 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

For describing the longitudinal spreading of any quantity of dissolved or suspended matter, or of water itself, along a steady-state estuary with periodic tides, a mathematical model is used which is, in principle, similar to that presented by Stommel. (auth)

3749 VERTICAL AND HORIZONTAL MIXING RATES OF RADIOACTIVE MATERIAL IN THE OCEAN. Y. Miyake and K. Saruhashi (Meteorological Research Inst., Tokyo). p.167-73 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Observations on the vertical distribution of radioactivity in the Pacific Ocean showed that presence of activity was mostly limited to the mixed layer above the thermocline in June 1954 (Miyake, Sugiura, and Kameda, 1954). In March 1955 the activity extended down to about 600 m below the surface, the thermocline being present at the depth of 75 m (Operation Troll, USAEC, 1956). If there is any biological transport of radioactive material in a vertical direction in sea-water, migration of plankton might be more effective than decomposition of organic debris in transporting radioactive material, although it would be only 10 to 20% of the physical mixing rate. When radioactive material diffuses out from a source point, the horizontal eddy-

diffusion coefficient may be obtained from the time change of the distribution of the activity. (auth)

3750 CIRCULATIONS IN THE BAY OF BENGAL AND THE ARABIAN SEA WITH REFERENCE TO SAFE DISPOSAL OF RADIOACTIVE WASTES NEAR THE INDIAN COASTS. A. A. Rama Sastry (Meteorological Office, Poona, India). p.175-88 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

A review is given of general knowledge of oceanographic conditions in the Bay of Bengal and the Arabian Sea. On the basis of studies made for some years by the numerous oceanographic stations which operate along the coasts of India, studies were made of such oceanographic conditions from the point of view of the safe disposal of radioactive wastes and, using data collected by various expeditions in the Indian Ocean, the physical oceanography of the region north of the equator was studied. Early knowledge of the oceanography of the Bay of Bengal and the Arabian Sea is reviewed. In the light of the numerous oceanographic stations occupied along the coasts of India, oceanographic conditions with reference to safe disposal of radioactive wastes into the sea are discussed. Utilizing the data collected by different expeditions to the Indian Ocean, the physical oceanography of the region north of the equator was studied. In the upper 200 m there are at least three different water masses both in the Bay of Bengal and the Arabian Sea. Because of very great dilution in the Bay of Bengal, the surface waters could be further subclassified. From horizontal distributions of various oceanographic parameters, circulation at different levels along the Indian coasts is given for the upper 150 m and the same is inferred down to 500 m from the vertical sections. The level of no motion seems to be well above the 500 m depth level and fluctuates both in space and time. Mixing of water is deduced from the T-S relations. The seasons of occurrence of upwelling and sinking along the coasts and the region affected are given. Intensity of upwelling along the coast is more pronounced and during that period a complete overturning of water over the continental shelf takes place. In deeper levels, water masses in the order of their abundance are the Indian equatorial water, Antarctic intermediate water together with Red Sea water, and a slight admixture of the Indian central water, Indian deep water, and the Antarctic bottom water. The distribution of these water masses and the deep water circulation north of the equator are given. During the past 60 years, the Antarctic bottom water seems to be advancing further north of the equator both into the Bay of Bengal and the Arabian Sea. Consequently, lowering of salinity is recorded both in the Bay and the Arabian Sea. A program of further oceanographic work in connection with the safe disposal of radioactive wastes, particularly into the Arabian Sea, is suggested. (auth)

3751 THE DISTRIBUTION OF ELEMENTS IN THE SEA. F. F. Koczy (Univ. of Miami, Fla.). p.189-97 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

The distribution of elements in the ocean by eddy diffusion is discussed. Eddy diffusion is known to vary with the depth. Different methods were used to determine the magnitude and the variations. Eddy diffusion shows two minima. One is seated in the thermocline and is supposed to coincide with the layer of no motion. The other one is a laminar friction layer close to the ocean floor. Above the layer eddy diffusivity shows a maximum and decreases logarithmically with the height toward the upper minimum. In the surface layer of the ocean is a second maximum of eddy diffusivity, which is caused by wind steering. Diffusion in the sediment is very low and is determined at about 10^{-9} cm^2/sec. The lower maximum was found by the distribution of radium in the deep sea to be between 2 and 30 cm^2/sec. The upper minimum seems to have a value of 10^{-2} cm^2/sec. For that reason in some parts of the ocean the deep sea floor seems to be suitable as a dumping ground for low-level radioactive wastes. Two graphs are given which show the distribution of an element released on the ocean floor in the ocean water when only eddy diffusion is considered and strong currents do not exist. Use of the ocean floor is not considered as a dumping ground for high-level waste products, but the possibility is discussed of disposing of some of this material in the sediment layer which may be an excellent receptacle for waste products. (auth)

3752 THE DEPTHS OF THE OCEAN AND THE QUESTION OF RADIOACTIVE WASTE DISPOSAL IN THEM. V. G. Bogorov, B. A. Tareev, and K. N. Fedorov (Oceanographical Inst., Academy of Sciences, Moscow). p.199-217 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In Russian and English)

There are 23 deep-water troughs with depths of more than 6000 m in the oceans of the world. None of the troughs has any morphological features which might prevent the free circulation of deep water in them. An increase in water temperature at the bottom of the troughs, beginning at a depth of 3 to 5 km, results in the vertical convective mixing of deep water. It was proved theoretically that in spite of the stabilizing effect of the earth's rotation, steady cellular convection will take place in the deep layers even when there are very small superadiabatic temperature gradients. The vertical distribution of oxygen, showing a characteristic increase in percentage saturation and absolute concentration with depth from a minimum level of 1000 m to the bottom, may be taken as evidence of the existence of both vertical and horizontal movements or horizontal mixing throughout the deep-water mass. Otherwise the biochemical consumption of oxygen (not less than 0.1 ml/liter per year) would lead to complete exhaustion of oxygen resources in deep water after a very short time (40 to 60 years). Horizontal currents with comparatively high velocities (5 to 17 cm/sec) were detected at depths of 1000 to 3000 m by direct measurements in the Atlantic and the Pacific Oceans. The physical circulation of water is not the only means by which dissolved and suspended materials are dispersed in the ocean. The continuous migration of living organisms adds to the risk that radioactive materials, which have accumulated in living tissue, will be dispersed and transmitted through the food chain over large distances at great speeds, which was the case after experimental atomic explosions in the Pacific. It must therefore be recognized that radioactive waste disposal in the deep water troughs cannot be permitted without endangering the health of the whole of mankind through radioactive contamination. (auth)

3753 SOME HYDROGRAPHIC STUDIES REQUIRED FOR ASSESSING THE EFFECTS OF ATOMIC WASTE DISPOSAL. D. L. Gordon. p.225-8 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

In order to assess the probable movement of effluent discharged into the sea, a sound knowledge of the cause of water movements and a practical knowledge of their

measurements are essential. Considerations are emphasized which should be borne in mind when those measurements and studies are carried out. Tidal streams, residual current, oceanic currents, and eddies are discussed, as well as the scope of the observations which are considered necessary. (auth)

3754 THE APPLICATION OF EXISTING OCEANOGRAPHIC KNOWLEDGE TO THE PROBLEM OF RADIOACTIVE WASTE DISPOSAL INTO THE SEA. D. W. Pritchard (Johns Hopkins Univ., Baltimore). p.229-48 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

The general approach to the over-all problem of disposal of radioactive materials into the sea is presented. Areas where oceanographic knowledge is required are indicated, and a general outline of the status of present knowledge in these areas is presented. Existing oceanographic knowledge is applied to waste disposal problems, including physical, chemical, and biological aspects. It is shown that, on the basis of existing oceanographic knowledge, fairly large amounts (megacuries per year) of packaged wastes can be disposed of into the deep sea without endangering man's safe uses of the sea. Low-level packaged wastes of the order of several hundred curies per year per disposal site could be safely disposed of on the continental shelf. Discharge of several hundred curies with the spent ion-exchange beds from nuclear-powered ships can be made into surface layers of the open sea without undue risk. The special aspects of near-shore and estuarine environments with respect to nuclear-ship operation are discussed. A discussion is given of some of the oceanographic research activities now under way in the United States applicable to the radioactive waste disposal problem. (auth)

3755 DISPOSAL INTO THE SEA AND INTO GEOLOGICAL STRUCTURES OF WASTES RESULTING FROM THE PEACEFUL USES OF ATOMIC ENERGY. Dayton E. Carritt (Johns Hopkins Univ., Baltimore). p.257-64 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Practices which lead to safe disposal of radioactive wastes permit the return of the wastes to man only at levels below maximum permissible concentrations, and do not prevent the development of resources which in the absence of disposal could make a significant contribution to man's well-being. The design of safe disposal procedures for any selected marine location is at present limited by our knowledge of several parts of the system which is involved in the return of radioactivity from the disposal site to man. Because of our present lack of knowledge, disposal procedures now being considered in the United States contain an unknown amount of "over-design" and, although they are believed to be conservative, are not unduly restrictive at present levels of waste generation. A better understanding of turbulent mixing processes in the oceans; the physical and chemical states of waste-product elements when in equilibrium with sea water; and the interaction of waste-product elements with the marine biota, their biological half life, and the extent of their concentration or rejection by marine organisms in all trophic levels, will provide the basis for a more efficient and safer utilization of the marine environment for the disposal of radioactive wastes. (auth)

3756 NEW RESEARCH REQUIRED IN SUPPORT OF RADIOACTIVE WASTE DISPOSAL. Milner B. Schaefer (Scripps Institution of Oceanography, La Jolla, Calif.). p.265-82 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Numerous physical, chemical, and biological processes influence the distribution of radioactive materials and their return to man. These include vertical and horizontal advection, turbulent diffusion, precipitation and sedimentation, uptake concentration, transport by organisms, and transfer to man through his food from the sea. Research is urgently needed on the flushing characteristics of typical harbors, estuaries, and open coastal waters, on diffusion and sedimentation processes in inshore waters, and on the passage of radioactive elements through the food web in this portion of the sea. Research is needed to delineate present and potential fishing areas, and nonfishing areas, by basic studies of biological productivity and other means. Studies are required to determine rates of transfer of radioactive materials between areas by horizontal advection and turbulent diffusion, rates of dilution by diffusion, sedimentation, and vertical transport, and rates of uptake and transfer by the biota. Research is required on efficient means of monitoring waste disposal areas. The ability of certain organisms selectively to concentrate particular elements offers a possible economical basis of monitoring radioactive wastes in the sea at very low concentrations. Specific research proposals were recently developed by several groups of oceanographers in the United States. These are summarized, together with cost estimates. (auth)

3757 OCEANOGRAPHIC RESEARCH REQUIRED IN SUPPORT OF RADIOACTIVE WASTE DISPOSAL. Bostwick H. Ketchum (Woods Hole Oceanographic Institution, Mass.). p.283-91 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

For low-level waste disposal in coastal waters the character of the biota and the eating habits of local human populations will determine the safe limits of contamination. In such a situation the sedimentary bottom populations will be important, since they will be exposed continuously, while planktonic and fish populations will drift through or enter the area of contamination sporadically. In the open ocean planktonic populations are of prime importance, both as the food supply of pelagic edible species and because they may be effective in transporting isotopes. Similar questions face biologists studying either sedentary or planktonic populations. These include the need to know the distribution and density of populations of various species, the rate of growth of the individuals and of the populations, the seasonal cycle of production and of abundance, the ability of various organisms to accumulate various elements, and the ways in which these elements are transported through the food web to the bottom through sedimentation or vertically within the water column through migration and exchange. For each specific waste disposal problem a survey of the local biota will be required, as will the subsequent monitoring of the operation. (auth)

3758 MONITORING OF FRESH WATERS USED FOR DISPERSAL OF RADIOACTIVE WASTES. I. L. Ophel (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.323-8 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

The Ottawa River has a low solids content with little plankton. Effluent is diluted into a great volume of low-activity cooling water and enters the river at a concentration of radionuclides less than the MPC_w for occupational workers. The concentration of total B γ radionuclides

above the plant is 2×10^{-6} μc/ml; at 1.6 km below the plant it is 3×10^{-6} μc/ml. Sampling of the river bottom shows that its radioactivity has decreased for several years in spite of continuous addition of activity adsorbed on colloidal silica deposited from the water. Large fish are the only river organisms used by man. Traces of Sr^{90} are occasionally found in the bones, but none in the flesh. Although P^{32} forms only 0.04% of the total radioactivity found in the effluent, it makes up 75 to 95% of the total radionuclides found in most samples. A maximum concentration of 10^{-3} μc/g wet weight was found in the whole bodies of small perch. (auth)

3759 SAMPLING DEVICES FOR WATER AND SOIL. W. F. Merritt and P. J. Parsons (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.329-38 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959, Vol. 2." (In English)

Movement of radioactivity below ground is monitored at Chalk River by several methods. Sealed aluminum pipes are set in the ground down to the glacial till. A battery-operated Geiger counter is lowered down the pipe on a cable. It can detect activity of 20 to 50 dpm/ml dissolved in ground water. A portable γ-ray spectrometer is being developed for use in these dry wells. Ground water is sampled at fixed depths by Alundum thimbles connected to the surface by polythene tubing. Samples are withdrawn into an evacuated flask. Several thimbles can be taped to a rod that is positioned inside a casing driven to the required depth; the casing is then withdrawn, leaving the thimbles in position in the soil. Porous bronze piezometers can be pressed or driven to any depth in the absence of rock. Water passes freely through the bronze and is withdrawn into an evacuated flask. Multiple samples of soil may be taken at a series of preselected depths in one hole by samplers set inside connected section of drill rod. Each sampler is a hollow rod pierced by slits which are closed during drilling by a piston. For sampling, the piston is slightly withdrawn and the rod twisted. A second piston, attached to the first, is then drawn up to close the slots and the string of samplers is lifted from the hole. Undisturbed samples of sand are taken below the water table by a sampler containing an air bell which enables the sample to be withdrawn into an air cavity and be held in the tube by air pressure while the sampler is being brought to the surface. (auth)

3760 A REVIEW OF RADIOACTIVE WASTE DISPOSAL TO THE GROUND AT HANFORD. D. W. Pearce, C. E. Linderoth, J. L. Nelson, and L. L. Ames, Jr. (General Electric Co., Richland, Wash.). p.345-63 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959, Vol. 2." (In English)

The disposal of radioactive wastes to the ground from the Hanford separations plants is summarized; volumes of wastes and contained curies discharged to swamps, trenches, and cribs are presented. Significant literature on ion-exchange studies using Hanford soils is reviewed. A field experiment with a model crib is described; preliminary findings indicate that spreading a waste solution below a disposal facility may be of greater benefit in disposal operations than previously assumed. Further studies with the calcite–phosphate reaction are reported; significant variables which affect Sr^{2+} removal are calcite surface area, pH of the influent, flow rate, temperature, and phosphate ion concentration. Bone-seeking radioisotopes are also removed from F^- solutions when contact is made with calcite. The zeolite clinoptilolite shows high selectivity for Cs^+ even in the presence of increased Na^+ concentration. The effect of the large-scale ground disposal operation at Hanford is described by means of a map and geological cross sections showing areas and volumes of ground and ground water contamination. (auth)

3761 DISPOSAL OF RADIOACTIVE WASTES IN NATURAL SALT. F. L. Parker, W. J. Boegly, R. L. Bradshaw, F. M. Empson, L. Hemphill, E. G. Struxness, and T. Tamura (Oak Ridge National Lab., Tenn.). p.365-84 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959, Vol. 2." (In English)

The proposed use of cavities in salt formations as a disposal site for radioactive wastes is based upon (1) existence of salt for geologic time periods; (2) the impermeability of salt to the passage of water; (3) the widespread geographical distribution of salt; (4) the extremely large quantities of salt available; (5) the structural strength of salt; (6) the relatively high thermal conductivity of salt in comparison with other general geologic formations; (7) the possible recovery of valuable fission products in the wastes injected into the salt; (8) the relative ease of forming cavities in salt by mining, and the even greater ease and low cost of developing solution cavities in salt; and (9) the low seismicity in the areas of major salt deposits. Radioactive liquid wastes can be stored in cavities in natural salt formations if the structural properties of the salt are not adversely affected by chemical interaction, pressure, temperature, and radiation. Analytical studies show that it is possible to store 2-year-old 10,000 Mwd/ton, 800 gal/ton, waste in a sphere of 10 ft diameter without exceeding a temperature of 200°F. Laboratory tests show that the structural properties and thermal conductivity of rock salt are not greatly altered by high radiation doses, although high temperatures increase the creep rate for both irradiated and unirradiated samples. Chemical interaction of liquid wastes with salt produces chlorine and other chlorine compound gases, but the volumes are not excessive. The migration of nuclides through the salt and deformation of the cavity and chamber can only be studied in undisturbed salt in situ. One-fifth-scale models have been run in a bedded salt deposit in Hutchinson, Kansas, and full-scale field tests are in progress. (auth)

3762 MOVEMENT OF RADIOACTIVE EFFLUENTS IN NATURAL WATERS AT HANFORD. J. F. Honstead, R. F. Foster, and W. H. Bierschenk (General Electric Co., Richland, Wash.). p.385-99 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959, Vol. 2." (In English)

The Hanford plant is located in a semiarid region on a very thick bed of unconsolidated water-deposited sediments resting on the basalt bedrock. This material may be considered in two geologic units, the lower bed being much less permeable than the upper. The Columbia River flows through the plant area and it is first used for human consumption about 55 km down-stream from the last reactor plant. Low-level effluent from the reactors is discharged into the Columbia River after a 1 to 3 hr holdup period in retention basins. More than 60 radioisotopes were identified in the effluent, nearly all of very short half-life. Depletion of various radioisotopes in river water by mechanisms other than decay is observed. This averages about 40% in the 55 km between the reactors and Pasco and is ascribed to biological assimilation and sedimentation processes. Low-level waste solutions from chemical processing plants are discharged into the ground where

they seep through 70 to 120 m of sediments before reaching the local water table. Most of the radioactive material is immobilized by adsorption or other reactions during passage through the soil. The water and the few contaminants that reach the water table move with the ground water toward the Columbia River. The rate and direction of travel are determined by the form of the water-table surface and the hydraulic characteristics of the transmitting aquifers. The local water-table configuration was radically affected by the disposal of large volumes of water. From the gradient and the measured permeabilities of the aquifers an average "travel time" for water of 180 years is estimated. It is recognized that the maximum velocity may be several times the average. The effect of adsorption or other reactions is to greatly slow down the movement of dissolved material relative to the rate of movement of the water. No movement of fission products from the disposal sites to the river was detected. (auth)

3763 DISPOSAL OF LOW-ACTIVITY WASTE AND ACCUMULATION IN CULTIVATED SOILS. G. Barbier (Central Agricultural Research Station, Versailles, France) and G. Michon. p.401-6 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In French and English)

A method is described for accumulating long-lived radioisotopes in soils and calculating the maximum contamination they would cause in vegetables grown on these soils. A way is suggested for expressing this contamination and a formula is given by which the maximum contamination of 1 kg of the harvested produce in relation to the tolerated contamination per liter of irrigation water could be calculated. (auth)

3764 ENVIRONMENTAL IMPLICATIONS OF RADIOACTIVE WASTE DISPOSAL AS RELATED TO STREAM ENVIRONMENTS. Conrad P. Straub, Abraham S. Goldin, and Albert G. Friend (Robert A. Taft Sanitary Engineering Center, Cincinnati). p.407-19 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Increasing volumes of radioactive waste materials are being introduced into streams annually. These originate from the many laboratories in which radioactive materials are used for beneficial purposes, as well as from existing atomic energy facilities. To these amounts introduced directly into the river under essentially controlled conditions must be added those radioactive materials originating from fall-out and feeding into the stream through run-off or direct deposition. Since these same streams may serve a multiplicity of purposes, as for example, potable and industrial water, recreation, fishing, irrigation, and navigation, the effect of these discharges on each of these activities must be carefully evaluated. Present criteria do not provide a complete basis for determining permissible levels of discharge unless information is available on the amounts of specific radionuclides already present and the fate of these same nuclides in the downstream environment. Permissible levels of discharge will have to be modified in accordance with this information and particularly in terms of the uses to which the downstream water course is put. Where several sources of discharge are to be permitted on a given water course, allocation of maximum amounts of specific radionuclides must be established in accordance with downstream exposures of populations from all sources. Several suggested approaches to the handling of this problem of waste management in relation to downstream uses are outlined and some of the difficulties associated with the application of each approach are considered. (auth)

3765 SORPTION REGULARITIES IN BEHAVIOUR OF FISSION-PRODUCT ELEMENTS DURING FILTRATION OF THEIR SOLUTIONS THROUGH GROUND. V. I. Spitsyn, V. D. Balukova, V. V. Gromov, S. I. Zakharov, B. P. Zhagin, and F. M. Spiridonov. p.421-34 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In Russian and English)

Research on the sorption of radioisotopes under natural conditions employing the controlled filtration process was performed. Radioisotopes were introduced into the solution as soon as filtration had become steady and the process continued for four months. Soil samples were taken by drilling at different depths and analyzed to determine their radioisotope content. Diffusion of radioisotopes was observed at depths of 10 m; two distinct boundaries of soil-activity decrease were ascertained: at the surface of the site and at the depth of the solution filtration front. The radiostrontium absorption by natural sorbents, principally pure minerals widely distributed in soils and subsoils, was investigated separately. The presence of calcium ions, even in small quantities, sharply reduces the degree of radiostrontium sorption. Other conditions being equal, strontium may be absorbed to a greater extent than calcium, according to the composition of the sorbent. The field investigations of radiostrontium sorption and migration showed that when filtering radioactive solutions two possible variants have to be considered. In the first case the solutions are discharged into soil unaffected by any flow of ground water. In this situation the radiostrontium is retained by the soil. In the second case, the radioisotopes proceed directly into the water-bearing horizon. The radiostrontium will then migrate with the ground water flow and through the soil and this migration will be further affected by the sorption and desorption processes occurring. The experiments performed demonstrate the ease with which long-lived radioisotopes migrate under natural conditions and call attention to the need for thorough study of ground water problems in connection with various methods of disposing of radioactive waste into ground. (auth)

3766 A FUNDAMENTAL STUDY ON THE INFILTRATION CHARACTERISTICS OF RADIOACTIVE LIQUID WASTES. Shigehisa Iwai, Takeshi Goda, and Yoriteru Inoue (Kyoto Univ.). p.435-48 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

When a liquid waste containing radioactive substances is released or leaked out at a disposing site or from a plant using atomic energy or nuclear products and spread over the ground surface in that place, it will percolate into the soil and any adsorbable substances contained in the liquid will be partly adsorbed by soil particles. As one of the fundamental studies on this problem, the motion of liquid through unsaturated porous media is discussed and then a theory is introduced to estimate the variation of the concentration of radioactive substance in the flowing liquid. The validity of this theory is examined quantitatively by laboratory experiments with a filter column. (auth)

3767 WASTE DISPOSAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES OF AMERICA. E. G. Struxness, K. E. Cowser, W. de Laguna, D. G. Jacobs, R. J. Morton, and T. Tamura (Oak Ridge National Lab., Tenn.). p.481-98 of "Disposal of Radioactive Wastes. Conference

Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

A review of the waste disposal research and development carried out in the United States is given. The major research effort concerns the conversion of high-level liquid wastes into solids. At Hanford and Oak Ridge low-level wastes are disposed to the ground in pits, cribs, and lagoons. Geochemical studies related to waste disposal are conducted at Hanford, Oak Ridge, and the University of North Carolina. Experiments with soil columns are described; these are more effective for the decontamination of waste streams than either cribs or pits. The most suitable exchange materials for the soil columns are found to be vermiculite supported by rock phosphate and the latter supported by graded gravel. The progress of research work on the possibility of injecting radioactive liquid wastes into porous formations through deep wells and disposing of radioactive wastes in impermeable formations by hydraulic fracturing is outlined. (auth)

3768 DESIRABLE NEW GEOLOGIC RESEARCH IN SUPPORT OF RADIOACTIVE WASTE DISPOSAL AS INDICATED BY HANFORD EXPERIENCE. Randall E. Brown (General Electric Co., Richland, Wash.). p.499-516 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

All disposal of radioactive wastes to land relies on the geologic environment. Disposal to that environment is not ultimate since no material is impermeable, unleachable, or noncorrodible when geologic time is considered. Hanford's disposal interjects a maximum of geologic features between disposal sites and the point of nearest public exposure. This is the "delay-and-decay" concept named by Simpson. Problems involved in disposal at Hanford include (1) the quantitative inexactness of geology, (2) the lack of isotropic homogeneous earth materials, (3) determination of the quantitative importance of deviation of geologic and hydrologic features from an average, and (4) determination and measurement of the parameters of interest. Cases at Hanford are cited to illustrate these points. Wells totaling 557 in number and 33,000 m in depth were drilled, but provide data that must be cautiously used. Standard aquifer performance tests are limited in value, since unit and directional permeabilities are integrated into average values. Ion-exchange studies provide quantitative values of direct interest, helping to interpret geologic features. Hydrologic studies, correlated to the soil chemistry work and the geologic data, result in logically explainable geologic controls to ground water movement. Disposal to ground of radioactive wastes is neither a cure-all nor something to be feared. The integration of data from studies by geologists, hydrologists, geochemists, and mathematicians has gone far to assure the safe disposal of wastes to ground at Hanford. A great amount of work remains to be done. (auth)

3769 SUMMARY OF CURRENT GEOLOGICAL RESEARCH IN THE UNITED STATES OF AMERICA PERTINENT TO RADIOACTIVE WASTE DISPOSAL ON LAND. E. S. Simpson (Geological Survey, Washington, D. C.). p.517-31 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

Research in geology may be divided into three categories according to the degree of containment required for the waste in order to assure conformance with generally accepted standards of health and safety. (I) Maximum containment environments are intended to retain for centuries or for millenia essentially all waste materials stored in them. Two general types are under investigation, salt deposits and deep permeable formations. In both cases various laboratory experiments are being performed to study the interaction between waste solutions and appropriate earth materials, and, in the case of salt, a field experiment is in progress utilizing simulated (nonradioactive) high-activity waste. (II) Intermediate containment environments are intended to slow down significantly the mobility of radioactive wastes to provide sufficient time for radioactive decay before the wastes come into contact with man or his food chain. Examples of intermediate containment are shallow burial of packaged waste and discharge of bulk liquid waste into seepage pits. Research is in progress to study the combined effect of transport of radionuclides by ground water and retention of radionuclides by sorption on earth materials. (III) Environments of no containment are those in which radionuclides are immediately brought into contact with man or with any of the biota of his food chain. Research is under way both to determine the capacity of individual environments to receive such waste within health and safety limits and to improve techniques for doing so. Current research includes (a) classification of terrains as related to waste disposal problems, (b) study of diffusion characteristics of streams, (c) the effect of organic and inorganic stream solids on radioactivity concentration, and (d) the effect of suspended sediment and river-bed material on the transportation of radionuclides. (auth)

3770 THE CONTAINMENT OF RADIOACTIVE WASTES IN DEEP GEOLOGIC FORMATIONS. W. J. Kaufman (Univ. of California, Berkeley). p.533-46 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

The disposal system employing deep formations of the earth is conceived to consist of a pattern of injection wells for introducing the waste, and of relief wells which serve to reduce well-head pressures, permit monitoring, and direct the flow in such a manner as to make maximum use of the formation. Information needed for the design of such a system includes data on the dispersion or short-circuiting properties of the formations, ion-exchange characteristics of the media, and the chemical and radiochemical properties of the waste. A two-well prototype injection system is in operation at the Engineering Field Station of the University of California. (auth)

3771 DISPOSAL OF RADIOACTIVE WASTE IN THE SUBSURFACE OF THE FEDERAL REPUBLIC OF GERMANY. GEOLOGICAL AND HYDRO-GEOLOGICAL PROBLEMS. R. Wager and W. Richter (Bundesanstalt Für Bodenforschung, Hanover). p.547-51 of "Disposal of Radioactive Wastes. Conference Proceedings, Monaco, 16-21 November 1959. Vol. 2." (In English)

The geological and hydrogeological problems related to the subsurface disposal of radioactive wastes in the Federal Republic of Germany are outlined. Special consideration is given to the possibility of storing solid and liquid wastes in the salt domes widespread in the northwest, and of injecting liquid waste into deep reservoirs containing briny water and located in favorable geologic structures. (auth)

NO. 3

con-
nturies
ed in
alt de-
s vari-
study
late
erimen
igh-
nments
of
dioac-
man
ment
of bulk
ess to
les by
tion on
nt are
nt into
chain,
y of
n
or
on of
study
t of
con-
and
lides.

WASTE
(Univ.
tadioa
1 No-

the
wells
erve to
direct
of the
a sys-
ng
ristics
oper-
tem is
niver-

THE
ER-
PROB-

o,

ed to
Fed-
dera-
uld
, and
ing
res.